Weatherwise

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VOLUME 9 · NUMBER 1

FEBRUARY 1956

"SOME PEOPLE ARE WEATHERWISE BUT MOST ARE OTHERWISE"—BENJAMIN FRANKLIN

WEATHERWISE

THE MAGAZINE ABOUT WEATHER

DAVID M. LUDLUM, *Editor* HENRY W. BULKLEY, *Associate Editor*

AMS Elections and Awards

THE election of a new slate of officers was made at the 36th Annual Business Meeting during the 143rd National Meeting in New York City on 25 January 1956.

The President of the Society for 1956–57 will be Dr. Robert D. Fletcher, who is currently serving as Director, Scientific Services, Air Weather Service, U. S. Air Force, Washington 25, D. C. As Vice-President we shall have Capt. Frederic A. Berry, on loan from the U. S. Navy and acting as Chief Scientific Advisor, Advisory Committee on Weather Control, Washington 25, D. C.

Dr. Henry Houghton of Massachusetts Institute of Technology will serve another term as Secretary, as will Mr. Henry Ward of Boston, Massachusetts, in his role as Treasurer.

The new councilors for three-year terms are:

Dr. Harry Wexler, U. S. Weather Bureau, Washington.
Brig. Gen. Joseph J. George, Eastern Airlines, Atlanta.
Dr. Helmut Landsberg, U. S. Weather Bureau, Washington.
Major Philip Thompson, U. S. Air Force, Washington.
Dr. Werner A. Baum, Florida State University.

At the annual banquet of the Society two awards were made. Gen. Joseph George received the First Annual Award for Outstanding Contribution to Applied Meteorology. *The New York Times* was the recipient of the Society's Award to a Corporation for Outstanding Service in the Advancement of Meteorology.

Vol. 9, No. 1 February, 1956

CONTENTS

New Year's Greeting from President Merewether
— Arthur F. Merewether 3

The Weather and Circulation of 1955
— William H. Klein 5

The 1955 Hurricane Season
— Robert C. Gentry 11

Drought—1955
— James D. McQuigg 14

Major Floods of 1955 16

Tracking Tornadoes in 1955
— Robert G. Beebe 18

Snowfall Notes for Winter 1954–55
— David M. Ludlum 22

Report of the Executive Secretary 26

Weatherwatch
— David M. Ludlum, Ed. 32

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New Year's Greeting from President Merewether

IT may appear a bit presumptuous for me to extend this New Year's Greeting when, in fact, by the time you read this, there will be a new President at the helm of our Society. By way of explanation, the mere mechanics of getting out this issue of *Weatherwise* makes it impossible to know who the new President will be, and also, as your Editor explained to me, this is a review of the past year.

As you know, progress in meteorology is slow, pitifully slow in comparison with some of the spectacular advances in electronics, nuclear physics, aviation, and other sciences. This is so because of the enormous complexity of the weather processes, and the relatively very small effort in terms of both money and manpower that is exerted in our field. Nevertheless, progress has been made, and events of the past year do reflect the continuing growth of our Society and the greatly expanded public interest in weather, and weather forecasts especially. Two events are particularly significant, I think—the continued increase in the Society's membership and the considerably larger amounts of money appropriated by Congress for the Weather Bureau.

Membership has increased by about 10% during the past year, so that we now number well over 5,000. This is good, but it is not good enough. There are still far too many free-loaders who, though earning their living in weather, still refuse to support the Society which is carrying the ball for the science of meteorology and all meteorologists in this country.

During the past year the Society has held or co-sponsored eight national scientific meetings from New York to Honolulu, covering subjects ranging all the way from an artificial earth satellite to what makes it rain, from smog in Los Angeles to hurricanes in New England. All these meetings have been surprisingly well attended, and each year there are demands that more be held. Additional evidence of the continual expansion in the meteorological field is the increasing number of scientific articles being published by the Society. This past year both the *Bulletin* and the *Journal* have been enlarged to contain 600 or more pages in each annual volume. Although no Monographs were issued in 1955, several are under way and should be published this year. In preparation are: *Integration of Sea and Atmosphere, Meteorology of Soaring Flight,* and *Climatic Criteria Defining Efficiency Limits for Certain Industrial Activities.* Others have been proposed.

Progress is being made on *A Glossary of Meteorology* which we hope will be published by the year's end. Work is also going for-

ward on the *Meteorological Research Review* under the editorship of Professor James Miller, and this new book covering the latest advances in a number of different areas should be available before the year is concluded. *Dynamic Meteorology and Forecasting* by Bjerknes, Bergeron, and Bundgaard will be published by the Society and should be available shortly.

Our various committees have been active and, though visible results are often slow in materializing, action is going forward on many fronts. Our Agricultural Meteorological Committee sponsored an excellent session at the Kansas City meeting in June, spurring considerable interest in a field which has been somewhat neglected in recent years. The Radio and TV Committee has several projects under way, including plans for a joint session with representatives of the radio and TV industry in Hartford in March. Other projects include ways and means of improving the presentation of weather to the public; and in this connection the Society can already take credit for getting one unsatisfactory presentation off the air.

The Radar Committee has been particularly active, sponsoring the Radar Conference at Asbury Park in September. Radar meteorologists are a dynamic group. They are fully aware of the importance of the scientific break-through resulting from the use of this new tool and are enthusiastic in their endeavor to press on further.

The Committee On the Interaction of the Sea and Atmosphere sponsored an excellent session on that subject at the Washington meetings in May. As evidence of the increased interest of Congress in weather problems, Senator Theodore Francis Green of Rhode Island presented a paper entitled "A Legislator Views the Storm Tide Problem" at the session, and Congressman and Mrs. James T. Patterson of Winsted, Connecticut, attended our banquet during this meeting. Ironically, Winsted was one of the towns to be severely damaged by Hurricane Diane's rains later in the year, as were parts of Rhode Island also.

On the more material side, it was with the assistance of the Society that entrance pay rates for professional meteorologists entering government service at the GS-5 level were increased from $3,670 to $4,345 per year. This brought their pay up to the same rates being paid engineers and professional men in certain other physical sciences. The Society's advice on matters of this nature is being sought more and more.

The field of industrial meteorology continues to expand. To mention only one example, we cite the new weather forecasting, broadcasting, and research station established this past year by the Travellers Insurance Company in Hartford, Connecticut. And through the Weather Corporation of America, a new award in Industrial Meteorology has been established by the Society, carrying an honorarium of $500 each year.

In the field of weather control we have nothing new to report, but call your attention to the fact that Captain Orville's Committee on Weather Modification makes its report to Congress on or before 1 July 1956.

During the past year this nation has been badly battered from coast to coast by severe storms that have taken the lives of hundreds and caused damage in the billions. In the spring tornadoes wiped out Udall, Kansas, part of Blackwell, Oklahoma, and damaged other communities. In the fall hurricanes smashed the East Coast and flooded many cities and towns from the Carolinas to New England. As a grim reminder that weather plays no favorites, floods during the Christmas holidays overwhelmed parts of California and Oregon.

Recognizing the deficiencies in the state of our knowledge of and in our ability to forecast for severe storms, the Society over a year ago strongly endorsed increased research in this area; recommended the appropriation of special funds by Congress to enable the U. S. Weather Bureau, in cooperation with other public and private agencies, to conduct research projects on tornadoes and on hurricanes; and appointed a Committee on the Promotion of Research on Severe Storms to get action by any suitable means. Subsequently, the Congress did considerably increase the Weather Bureau's appropriations as mentioned below, and in December the Weather Bureau held a conference on severe storms in Washington, attended by a hundred meteorologists representing various government and private agencies, to discuss various phases of severe storm research. Two

(*Continued on page 29*)

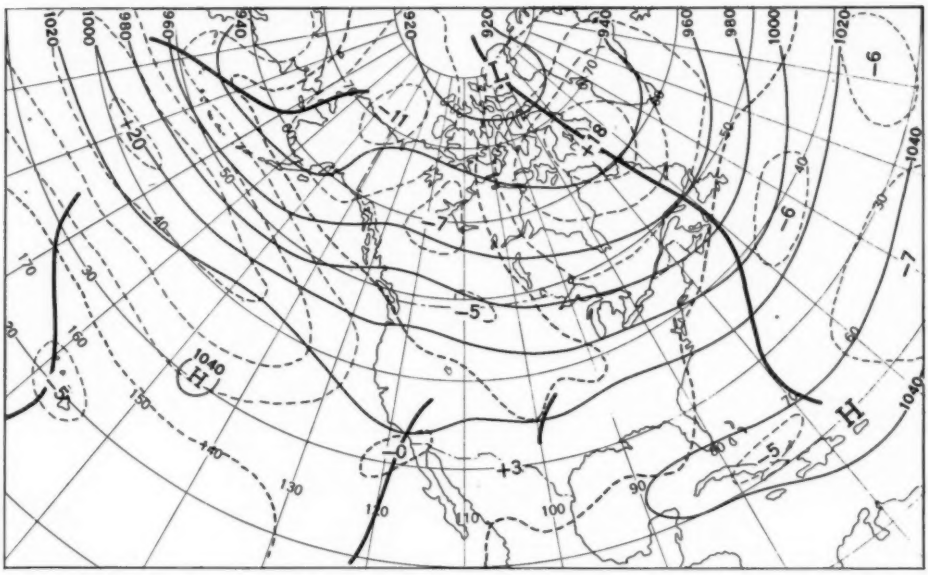


FIG. 1. Mean 700-mb contours (solid) and height departures from normal (dashed), both in tens of feet, for 12-month period from December 1954 through November 1955. Most prominent features are positive height anomalies in the Pacific at middle latitudes and in eastern North America at high latitudes.

The Weather and Circulation of 1955

WILLIAM H. KLEIN, *Extended Forecast Section, U. S. Weather Bureau, Washington, D. C.*

THE ANNUAL MEAN

THE general circulation of 1955 was characterized by several well-marked features which were both persistent and recurrent to an unusual degree. As a result the mean 700-mb map for the twelve-month period from December 1954 through November 1955, illustrated in figure 1, possesses considerable character, despite the long period over which it was averaged. Although the flow pattern (shown by the contours) is generally flat, the height departures from local normal (analyzed with dashed lines) focus attention upon several sizable anomaly centers.[1]

The most prominent features of figure 1 are two large centers of positive 700-mb height anomaly, one in mid-Pacific 200 feet above normal, and the other on the northeast coast of Canada with a central intensity of plus 180 feet. The Pacific center was part of a broad band of positive anomalies extending across the ocean at middle latitudes, but with below normal heights to the north. As a result, stronger than normal westerlies prevailed in most of this ocean between the latitudes of 45° and 65°N. The Canadian center, on the other hand, was of the typical "blocking" variety since it was accompanied by an extensive band of below normal heights at middle and low latitudes. Consequently, the prevailing westerlies were weaker and farther south than normal throughout the Atlantic Ocean and eastern North America. This "low index" circulation contrasted sharply with the "high index" pattern of the Pacific.

[1] The term anomaly is used extensively in the study of mean weather and climatological maps to express a departure from normal conditions.—*Ed.*

Positive Anomaly Centers

Positive height anomalies in the mid-Pacific and northeast Canada were prominent features of not only the annual mean, but also of most individual monthly maps during the year. The location and intensity of the center of positive height anomaly on each of these 30-day mean 700-mb maps were plotted,[2] and then the continuity shown in figure 2 was ascribed to each center. The Pacific center could be continuously traced on each of the 12 maps of the series. After originating in mid-ocean in December 1954, it oscillated over a narrow area at middle latitudes in the eastern Pacific during the first five months of 1955. It then appeared to move rather regularly westward each month from May until November along the zonally elongated axis of the mean annual positive anomaly (fig. 1), while its central intensity remained fairly constant.

Above normal heights in eastern Canada and the northern Atlantic were made up in a somewhat different fashion, as not one but three separate monthly mean anomaly centers traversed the area during the year (see fig. 2). The first originated in mid-ocean in December 1954, became a well-developed block in Davis Strait during January, and then moved eastward across Greenland and

[2] These maps are not reproduced here but have been published and discussed regularly in a series of articles on the weather and circulation of each month in the *Monthly Weather Review*.

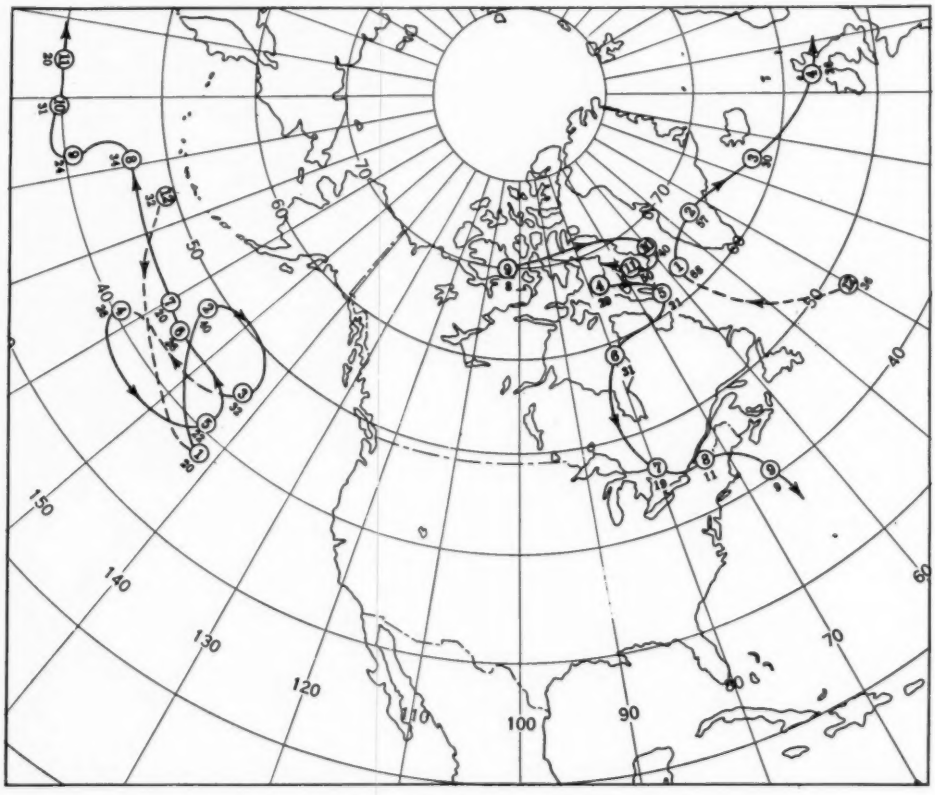


Fig. 2. Trajectories of two outstanding centers of positive 700-mb height anomaly during the year. Open circles locate the center of each anomaly on a series of 30-day mean charts computed on the last day of each month. The months are numbered consecutively inside each circle from 12 for December 1954 through 11 for November 1955. The number below each circle gives the intensity of the center in tens of feet. Trajectories are dashed in regions of less certain continuity.

Iceland to Scotland, where it dissipated after April. The second moved irregularly southward from its point of origin in northeast Canada in April to its last identifiable position in the Atlantic south of Nova Scotia during September. The third appeared along the Arctic coast of central Canada in September and then stagnated just north of Davis Strait during the ensuing three months. This general area was also the seat of positive anomaly centers during the months of January, February, April, and May, as well as the center of above normal heights on the annual mean map. It is especially noteworthy that the first and third of these individual anomaly centers attained their maximum intensity in this vicinity, while the first and second centers weakened progressively as they left it. Thus the Davis Strait area seemed to act like a focus of anticyclonic activity during the year 1955.

Latitude of the Jet

Figure 2 shows that the positive anomaly center varied over a wider range of latitude in the Atlantic-Canadian sector than in the Pacific. As a result, the former was more closely correlated than the latter with the latitude of the axis of maximum zonal wind speed. Month-to-month variations in the latitude of this jet axis at the 700-mb level, averaged over the western hemisphere, are portrayed in figure 3. The strongest westerlies were farthest north, around 52°N. during December 1954, July 1955, and August 1955. In each of these months the principal positive anomaly was south of the jet stream and at middle latitudes, between 45° and 50°N. The westerly axis was farthest south, on the other hand, between 37° and 40°N. during January, February, March, and November. During these months intense positive anomalies centered in the vicinity of southern Greenland acted like a block at high latitudes and displaced the jet stream south of its normal location.

Seasonal Breakdown

Figure 4 presents the four seasonal mean 700-mb charts of which figure 1 is composed. Persistence of the following features is noteworthy: positive anomalies in mid-Pacific and Davis Strait (except summer) and negative anomalies in the subtropical Atlantic, Hawaiian Islands, and northwest Canada (except winter). Figure 4 should also be compared with the charts on the next page showing the departure from normal of average temperature and precipitation in the United States each season. Note the prevalence of below normal temperatures in the Far West during all four seasons.

Winter

The circulation of the winter season was dominated by a strong positive anomaly centered in Davis Strait (plus 410 feet, fig. 4a). The blocking nature of this anomaly resulted in a southward displacement of the jet stream (fig. 3) and associated storm tracks, with rather cold stormy weather in Europe and the eastern United States as a consequence. These conditions were most pronounced during January, when mean pressures at sea level southeast of Newfoundland averaged 23 millibars below normal, the largest anomaly in any part of the Atlantic during any January in the 56 years of record dating back to 1899.

West of the Continental Divide generally cold dry weather prevailed because of northerly anomalous flow east of the positive center in mid-Pacific. Monthly mean temperature departures of as much as − 12° F occurred in the Great Basin during February, when the Pacific anomaly attained its maxi-

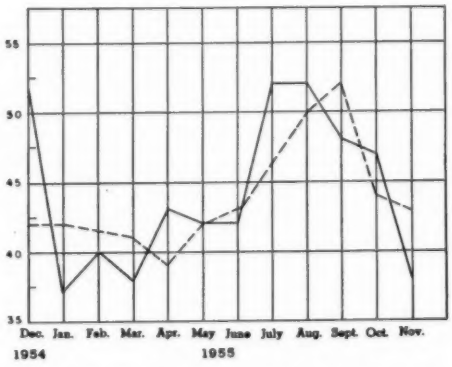


Fig. 3. Latitude of the strongest west wind component in the Western Hemisphere on 30-day mean 700-mb charts from December 1954 to November 1955. The normal for each month is indicated by a dashed line. The axis of the westerlies was north of normal during only four months of 1955.

THE CIRCULATION BY SEASONS 1955

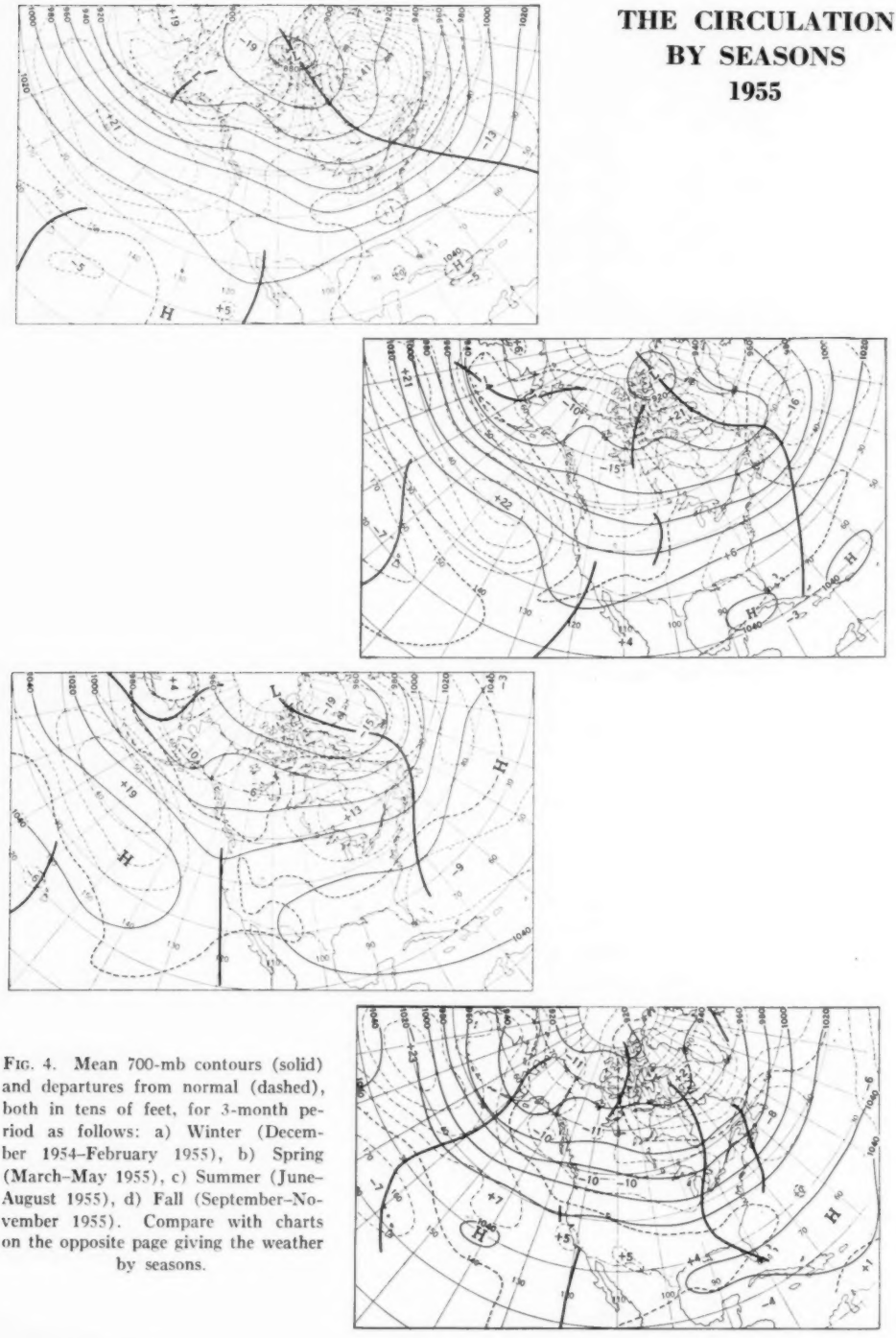
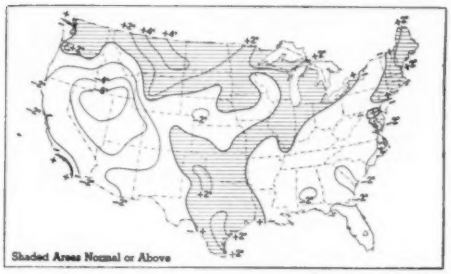
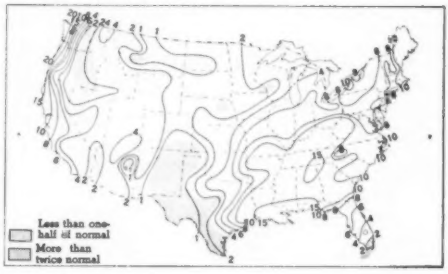


FIG. 4. Mean 700-mb contours (solid) and departures from normal (dashed), both in tens of feet, for 3-month period as follows: a) Winter (December 1954–February 1955), b) Spring (March–May 1955), c) Summer (June–August 1955), d) Fall (September–November 1955). Compare with charts on the opposite page giving the weather by seasons.

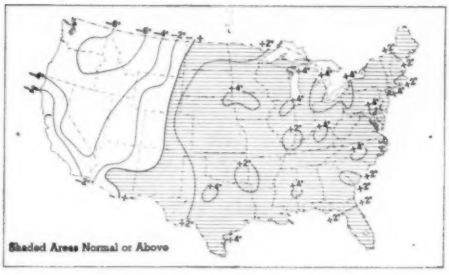
THE WEATHER BY SEASONS 1955

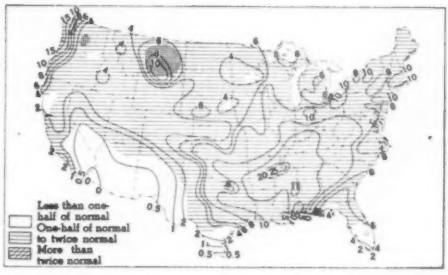
WINTER (DECEMBER–FEBRUARY) 1954–1955



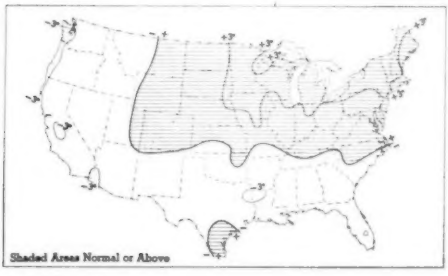


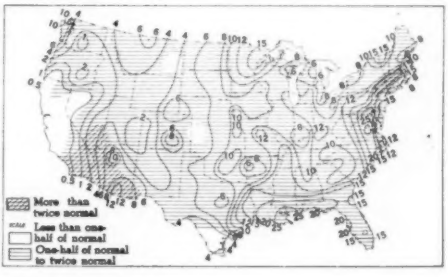
SPRING (MARCH–MAY) 1955



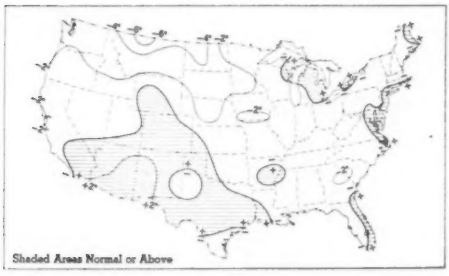


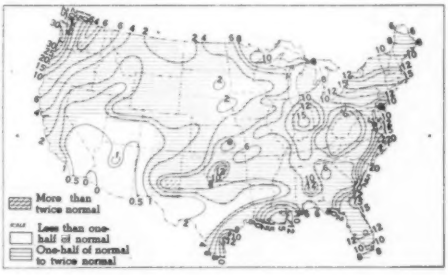
SUMMER (JUNE–AUGUST) 1955





FALL (SEPTEMBER–NOVEMBER) 1955





Charts show the departure of the temperature from normal in degrees Fahrenheit by seasons 1955. USWB charts.

Charts show the total precipitation in inches by seasons 1955. USWB charts.

mum intensity of the year (plus 400 feet, fig. 2). In central parts of the United States, however, winter temperatures averaged above normal because strong Pacific westerlies resulted in domination by mild maritime air masses. A contributing factor to this warmth was the prevalence of an abnormally deep cyclonic vortex over Alaska and the Arctic Basin, which inhibited the development of strong polar anticyclones at sea level.

Spring

The circulation of the spring season (fig. 4b) was relatively simple, consisting of deeper than normal troughs in the western half of North America, flanked by stronger than normal ridges in eastern portions of the Pacific and North America. The pattern of seasonal temperature anomaly in the United States was equally simple, with above normal temperatures in southerly anomalous flow in all sections of the country east of the 105th meridian, and below normal temperatures in stronger than normal northwesterly flow to the west of this meridian. This temperature pattern was remarkably persistent, particularly from April to May. The anomalies were most extreme during April, when departures of average temperature from normal averaged + 8° F in the Great Lakes area and − 8° F in Oregon. This strong temperature contrast across the United States was conducive to frequent cyclonic and frontal activity. Hence precipitation was widespread and abundant during the spring season, especially during May when up to 15 inches of rain fell in the erstwhile Dust Bowl.

Summer

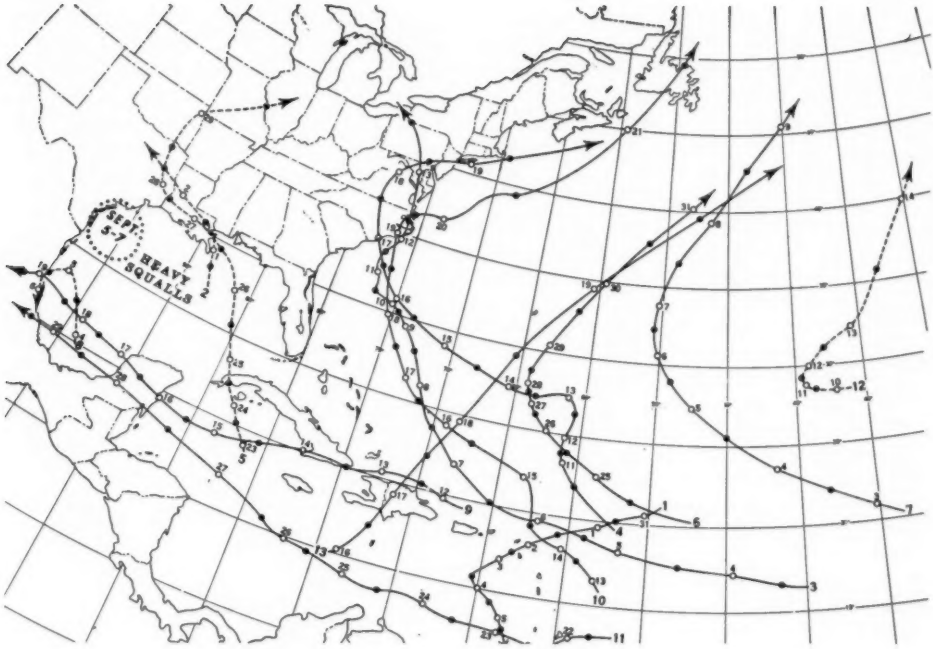
During the summer season the most extreme month-to-month weather and circulation reversal of 1955 occurred. June was dominated by a strong blocking ridge over Hudson Bay, deeper than normal troughs in the eastern and central parts of the United States, and southward displacement of the westerly jet. Consequently, both 700-mb heights and surface temperatures averaged well below normal in the eastern two-thirds of the United States.

During July, on the other hand, a record-breaking heat wave prevailed over the northern half of the United States from the Rockies to the Atlantic. This was effected by a sharp reversal in circulation as the positive anomaly center of figure 2 moved abruptly southward from Hudson Bay to the Great Lakes. At the same time blocking in the Atlantic and Canada relaxed, the axis of the hemispheric jet stream jumped 10° northward (fig. 3), and a warm anticyclone developed over the eastern United States.

The circulation and temperature patterns of July generally persisted throughout August. However, precipitation differed markedly in the Northeast, where flood-producing rains accompanying hurricanes Connie and Diane replaced a regime of drought. The early onset of the hurricane season and the northward shift of hurricane tracks were related to the fact that all features of the general circulation were displaced well north of normal during both July and August.

Fall

The circulation of the fall season in the Atlantic and North America (fig. 4d) returned to the prevailing pattern of the year (fig. 1). As in winter and spring, 700-mb heights averaged above normal at high latitudes from Iceland to Hudson Bay and below normal at middle latitudes. This was a blocking, low index, type of pattern which depressed cyclonic activity and resulted in below normal temperatures in much of the country. These conditions were most extreme during November, when the westerlies plunged far southward (fig. 3), and many low temperature records were broken in the northwestern quarter of the United States by abnormally cold air from Alaska and western Canada. The remarkable persistence of blocking action this fall is indicated by the fact that the 5-day mean 700-mb zonal index, (35°–55°N.), averaged over the western hemisphere twice a week, was below normal every period from October 28 to December 23, the longest period of continuous low index on record.



NORTH ATLANTIC TROPICAL STORMS OF 1955

1.	Alice	Dec. 31 (1954)–Jan. 5
2.	Brenda	July 31–Aug. 2
3.	Connie	Aug. 3–13
4.	Diane	Aug. 10–19
5.	——	Aug. 23–29
6.	Edith	Aug. 24–31
7.	Flora	Sept. 3–9
8.	Gladys	Sept. 4–6
9.	Hilda	Sept. 12–19
10.	Ione	Sept. 13–21
11.	Janet	Sept. 21–29
12.	——	Oct. 10–14
13.	Katie	Oct. 16–19

The 1955 Hurricane Season

ROBERT C. GENTRY

U. S. Weather Bureau
Washington, D. C.

THE 1955 hurricane season was another record breaker insofar as damage was concerned. This is true even though damage in the United States from hurricane winds was relatively light. The floods caused by the rains of Diane following so closely after those of Connie did more damage to property in the United States than any other hurricane of history. As in the 1954 season, the major portion of the hurricane damage in this country occurred in the northeastern states, an area formerly considered out of the hurricane belt. Damage from South Carolina southward through Florida to Texas, normally considered the hurricane belt, was comparatively minor. Total damage in the United States in 1955 from hurricanes was over one billion dollars and total casualties were 218.

Connie, Diane, and Ione were dangerous hurricanes while they were still at sea, even though each weakened considerably before striking land. There were several other major hurricanes during the season, and Janet, in particular, was one of the great hurricanes of the century.

Although there was a wide diversity in paths followed by the hurricanes, the 1955 season was notable for the grouping of several of the storms (fig. 1). Three hurricanes hit the North Carolina coast southwest of Cape Hatteras; two hurricanes and one near-hurricane pounded the Mexican coast in the Vera Cruz-Tampico area; two tropical storms entered the Louisiana coast within about 20 miles of each other; and three other hurricanes converged to the same area in the Atlantic northeast of Bermuda.

Advisories were issued for 11 storms, nine of which reached hurricane intensity. In addition, one tropical storm occurred so far out in the Atlantic that no formal advisories were issued. In the Gulf of Mexico in August a tropical disturbance developed storm characteristics just before reaching land. Although bulletins were issued about this storm, no name was assigned it. In the western Gulf region heavy squalls occurred on 5–7 September and nearly developed into a tropical storm. If these are counted, there were 14 tropical storms during the 1955 season, nine of which reached hurricane intensity.

Alice

Hurricane Alice originated in the Atlantic southeast of Bermuda from one of the winter storms which occasionally linger in that portion of the ocean. As Alice moved leisurely southwesterly, however, the storm took on tropical characteristics; and by the time the dangerous winds reached the Leeward Islands, Alice was a full hurricane with the typical warm core structure. Highest winds estimated by reconnaissance aircraft crews were about 85 mph. Several observers in the Leeward Islands reported winds from 65 to 85 mph.

As shown on the track chart (fig. 1), Alice passed through the Leeward Islands on 2 January and into the Caribbean Sea where the winds weakened rapidly on the 4th and 5th. During this hurricane the U. S. Weather Bureau issued hurricane advisories in January for the first time in history.

Although in dollar value the damage caused by Alice was comparatively minor, the effect on the economy of the small Leeward Islands was in many cases disastrous. Many schooners, sloops, and boats were lost, and crops and homes were heavily damaged.

Brenda

On 31 July a tropical storm formed over the northern Gulf of Mexico in a low pressure area which had drifted southward from northern Alabama during the previous two days. The storm moved north-northwestward until it reached the coast near the Louisiana-Mississippi border on the afternoon of 1 August when it turned west-northwestward. Highest wind reported was 50 mph at Shell Beach on Lake Borgne. Tides were 5 to 6 feet above normal at Shell Beach and 4.1 feet at the head of Mobile Bay.

Two people were killed in the Mobile area in car wrecks attributed to the storm. Property damage was relatively light and was mostly to small piers on the Mississippi coast and water damage to highways in southern Alabama, Mississippi, and Louisiana. Rains were heavy from northwestern Florida to Louisiana with many stations reporting 4 to 5 inches of rainfall.

Connie

Ship reports on 3 August indicated a disturbed area in the Atlantic near 45° West longitude. After receiving a report of 40-knot winds from the S.S. Bonaire, the Weather Bureau at San Juan issued the first advisory and located tropical storm Connie at 16.6° N., 48.0° W. at midnight on the morning of 4 August. The storm intensified gradually, becoming a full hurricane by the morning of the 5th. Movement was west-northwest until the 6th when Connie started a slow curve towards the Carolina coasts. By the 8th the rate of forward movement had begun to decrease and by the 10th the storm was moving only 5 to 8 mph. Until the afternoon of the 11th the movement was slow and erratic in direction. Connie then turned northward and crossed the coast near Cape

Lookout about 0830 EST, 12 August. After moving inland, Connie crossed North Carolina, passing east of Elizabeth City. As indicated on the attached track chart, the hurricane passed east of Washington, D. C., and crossed central Pennsylvania.

Reconaissance crews estimated the maximum winds in Hurricane Connie as high as 145 mph on 6–7 August, but the maximum speed decreased considerably while Connie was nearly stationary off the Carolina coast. The fastest measured mile at any coastal reporting station was 72 mph, and the peak gust was 83 mph at Wilmington, N. C. Winds of 75 mph were reported at Fort Macon near the point where the eye of the hurricane crossed the coast, but it was not established whether this was a measured or an estimated speed.

Six tornadoes occurred in the Carolinas early in the evening of 10 August while the hurricane was still offshore and before the winds from the hurricane had reached gale force along the coast. Five of these tornadoes occurred in South Carolina from Georgetown northward and one in North Carolina at Penderlea in northern Pender County.

Lowest pressure reported in Hurricane Connie was 27.88 inches and was measured on 7 August while the storm was still far from land. Lowest pressure at Fort Macon, N. C., near the landfall, was 28.40 inches.

In general, damage from Connie was comparatively light because the storm lost so much intensity while nearly stationary off the Carolina coast. Rainfall from Connie, however, was heavy from North Carolina to New England with amounts reported varying from about six inches at many stations up to the 12.20 inches which fell at La Guardia Field, New York, in a 38-hour period on 12–13 August. Although this rain did not cause excessive damage in itself, it did saturate the ground, fill the streams, and in general set the stage for the devastating floods which followed the passage of Hurricane Diane a few days later. About 25 people were killed in Hurricane Connie.

Diane

An easterly wave which had been followed for several days developed into a tropical storm on 10 August, and reached hurricane intensity that night. As indicated in figure 1, the storm's course was north until the 13th when it turned west, and then on the 14th began a slow turn towards the northwest and the North Carolina coast. Diane moved inland across Carolina Beach near Wilmington about 0600 EST, 17 August.

Highest winds were estimated at about 125 mph while Diane was still at sea on 12–15 August, but the hurricane winds decreased in force on the 16th and highest measured winds at coastal stations were gusts to 74 mph at Wilmington Airport. Winds were estimated at about hurricane force along the coast near Wilmington as the storm moved inland.

After Diane moved inland the winds further decreased, and as the gales subsided, so did the public's concern with the storm. Diane moved northward across North Carolina and Virginia into Pennsylvania before turning eastward for the coast—and then came the deluge! The torrential rains from Diane fell on ground still saturated from the rains of Connie. From the Poconos of Pennsylvania to southeastern New England, rain in excess of 8 inches was reported at many places. The greatest amounts, more than 18 inches, fell in the highlands northwest of Hartford, Connecticut. The combined totals of rain from Connie and Diane exceeded 20 inches in many places and all this rain fell within one 9-day period.

Flash floods almost obliterated many valley towns and drowned a number of people who either did not receive warnings in time or refused to believe that a flood breaking all records was coming.[1]

The loss of life, 184 deaths, was not large compared with some other disasters, but the property damage caused by the rains makes Diane our first billion dollar hurricane.

Edith

Hurricane Edith formed 24 August in an easterly wave. This hurricane moved west-northwesterly until the 26th when it started recurving and was moving toward the north-northeast by the 28th. This course took Edith well to the east of Bermuda. Highest

[1] Sumner, H. C., and O'Connel, Thomas J. "Hurricane Rains Cause Devastating Floods," *Weatherwise*, Oct. 1955, pp. 124–126.

(*Continued on page 29*)

Drought—1955

JAMES D. MCQUIGG, *U. S. Weather Bureau, Omaha, Nebr.*

IT is a small comfort to an individual farmer whose crops were ruined this year by a serious drought on his farm to know that the country as a whole had one of its most productive years.

Trying to compare one drought year with another is a difficult business. About the only safe comparison one can make is to note that each drought is different from the rest—different in areal extent, and different in how much the major crops are affected. We quote from the U. S. Department of Agriculture's *Crop Production,* issued 10 November 1955: "One of the Nation's most productive crop seasons rapidly moved toward a finish during October with generally good harvest progress. . . . High yields per acre for most crops feature the season's outcome despite numerous instances of local or sectional reverses. Crop reporters' opinions of yields of 'all crops' in percent of 'normal' in their localities show where drought struck hardest in the Great Plains central corn belt, and other areas. . . .

"An even more striking production success story is revealed by the indexes of yield and production put together from latest crop estimates. The 1955 yield index covering all crops now reaches all time high of 117 percent of the 1947–1949 base—zero percent above the 1948 previous record. Total production of all crops matches the record 106 of the 1947–49 base set in 1948. High yields per acre have more than offset total acreage reductions with surprising out-turns for a number of crops. . . ."

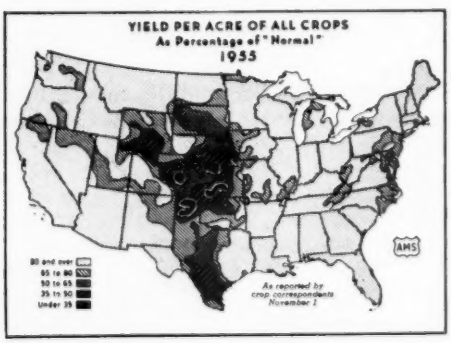
Corn, cotton, and soybeans were in large production this year. Of all the major crops, only wheat yields were sharply reduced, by acreage allotments and by drought and wind damage.

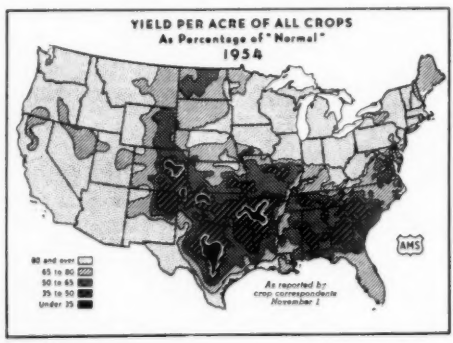
This situation is best illustrated by figures 1 and 2, which were taken from *Crop Production.* It should be noted that much of the damage to crops in the East Coast area shown on the map for 1955 was caused by hurricane winds and excessive rains, rather than by drought.

The remainder of this discussion will be confined to the area from South Dakota, western Iowa, and Wyoming southward into Texas—the area most affected by drought in 1955. Forerunners of trouble in these areas were the dust storms which swirled across the Great Plains, beginning in March and continuing to appear many times in April and early May. These storms and the accompanying dry weather did most of the damage to the wheat crops in the high plains.

One of the important "breaks" in the weather pattern of this season was the welcome rain throughout much of the dry area on 17–18–19 May. This put an end to the dust threat, revived many of the crops, and set the stage for fairly good growing conditions in the late spring and early summer.

June had cool weather and generally good though spotty rains. Much wheat acreage in the central and southern Great Plains was abandoned because of previous damage from





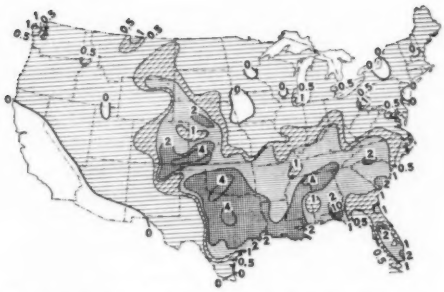


FIG. 3. Total precipitation in inches for the week ending Midnight, l.s.t., 22 May 1955. USWB chart.

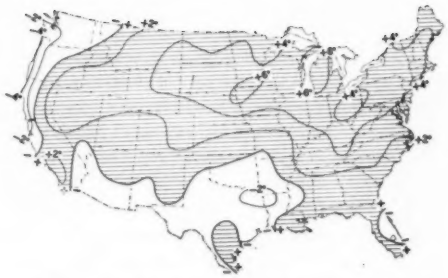


FIG. 4. Departure of average temperature from normal in degrees Fahrenheit, August, 1955. USWB chart.

drought and winds, but prospects were generally good elsewhere in the country.

A great amount of attention has been given to long-term cumulative effects of drought on major crops, and these are important. But the time and amount of even brief periods of rain during critical stages of development of each crop sometimes either cancel out or greatly magnify the previous cumulative effects.

A good example of this visited the corn crop in the western part of the Corn Belt. Most of the corn in this area was in first-class shape right up to the period before tasselling—in late July and early August. One good soaking rain during that period, accompanied by moderate temperature, would have resulted in record-breaking yields. Even in the areas that were hard hit, there were a few spotty showers that did come at the critical stage of development of the corn crop. Farmers tell of next-door neighbors with high corn yields, but a mile or so away yields were disappointing.

Most of the damage to the corn crop, then, was done by the dry hot weather of August, which carried on into early September. This pattern is illustrated by figures 4 and 5. One more significant "break" in the weather pattern of this year's drought came late in September and carried over into early October. Much of this rain came too late to improve major crops, but did help to rejuvenate pastures, lawns, and trees in the area and to replenish topsoil moisture, as shown in figure 6.

As this was being written, much of the drought area of 1955 was in need of several good soaking rains before the soil froze up for the winter.

November and most of December were very cold in the area most affected by drought in 1955. It was also very dry in the central and southern Great Plains. The unusual cold gave way to mild temperatures late in December, particularly in the area just east of the Rockies. This left the drought area very susceptible to wind erosion; a severe dust storm hit Kansas on 1 January 1956.

FIG. 5. Total precipitation in inches, August 1955. USWB chart.

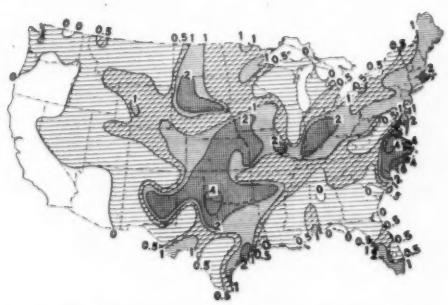
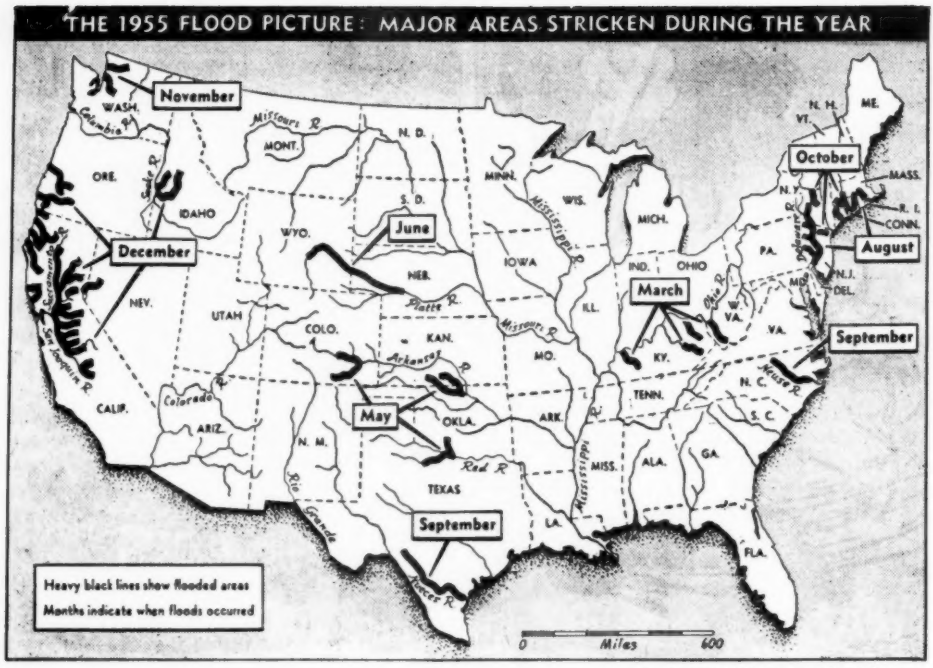


FIG. 6. Total precipitation in inches for the week ending Midnight, l.s.t., 25 September 1955.



Courtesy of *The New York Times*.

Major Floods of 1955

THE outstanding abnormality of the hydrologic year was the vast amount of moisture that was available for precipitation at critical times on both the middle Atlantic Coast and the middle Pacific Coast. In August and again in October, heretofore unprecedented amounts of rainfall were recorded in the highlands lying in an arc inland from New York City, and in December the coastal points and interior valleys of northern California received unprecedented concentrated rainfall in an 11-day period.

In the interior of the continent, though there were some beneficial rains at critical times in the growing season and the crop year was an excellent one from the total production view, the grip of the long-continuing drought still held the southern Plains and the middle Mississippi Valley in its hold at the year's end. It was a year of remarkable contrasts. New York City in 1955 had its driest January and driest December on record, yet August was the wettest of any month in the history of the local Weather Bureau. The same story was repeated in many other areas.

The first serious flooding in 1955 occurred in the Ohio Basin in March. Two storm periods from 26 February to 7 March put the headwaters in western Pennsylvania and West Virginia in flood stage, and several points on the Big Sandy River and its tributaries had their highest stages of record. Another storm on 21–22 March sent rivers in Tennessee and Kentucky to near-record heights. The main stem of the Ohio remained high throughout the month. At Cincinnati flood stage was reached for the first time since March 1952, and the river remained above the critical 40-foot level for a record number of 29 consecutive days.

The very heavy rains on 17–19 May, which broke the drought over the southern Plains and saved the crop season, sent the Arkansas River and many of its tributaries to high stages. The monthly total at Comanche, Kansas, in the erstwhile dust bowl area, was

18.05 inches. The flooding on the main river was confined to the section above John Martin Dam. Flash flooding occurred at a number of localities. The Cimarron River in Oklahoma had four distinct crests in the latter part of May. At Waurika a severe flash flood occurred on the morning of the 19th when water rose higher than in the great 1951 inundation.

Torrential rains associated with Hurricane Diane produced devastating floods in southern New England, eastern Pennsylvania, southeastern New York, and northern New Jersey, all within 100 miles of New York City, on 18–20 August. Both rains and floods were of record proportions and resulted in tremendous property damage. The ground had already been saturated by downpours from tropical air masses, and Diane's contribution ran off in unbelievable volume into the narrow valleys where unwitting man had placed his homes and factories. An appalling disaster resulted on the Delaware River and its tributaries: the Lackawanna, Lehigh, and Schuylkill; on the lower Connecticut along with the Farmington and Chicopee; and on the Naugatuck, Housatonic, Thames, and Blackstone, which empty into Long Island Sound or Narragansett Bay. The largest storm total was 19.76 inches at Westfield in southwestern Massachusetts, and the largest monthly total rainfall was 27.45 inches at Burlington, Connecticut—both figures unequalled previously. Most streams, especially those in narrow valleys, exceeded the previous high marks set in September 1938 during the New England Hurricane. Loss of life was estimated at 180 persons and the property damage figure ranged from one-half to one-and-a-half billion dollars.

A second series of disastrous floods struck much of the same area on 14–16 October when a low pressure system stalled near southern New England and poured great quantities of moisture on an already saturated soil. Storm totals of 14 inches were reported in the same areas which had received Diane's downpours. The main damage occurred in southwestern Connecticut, in the Danbury and Stamford areas, where many large industrial plants were forced to close. The main line of the New Haven R.R. was closed for four days, and normal traffic not restored for two weeks. The upper Delaware Valley and the Catskill Mountain area of New York State also had major flood losses. Total damage was estimated at $100 million.

On the 16th of December a series of disturbances commenced to move inland from the Pacific Ocean. Finding their normal path blocked both by extremely cold air over the interior and by the mountain barrier of northern California, they released record amounts of rainfall in a very short period. The most disastrous floods in the history of coastal and interior northern California and southern Oregon resulted.

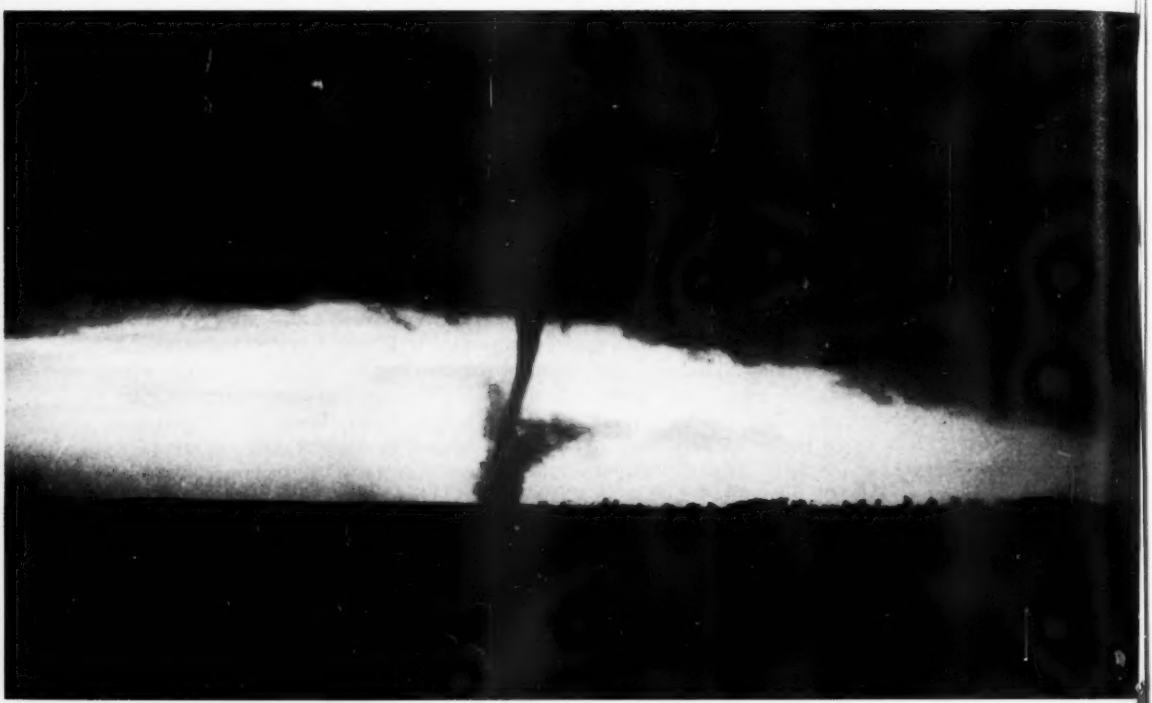
Flood stages in the tributaries of the Sacramento River in northern California surpassed all records, while in the lower Sacramento and lower San Joaquin basins the stages were very near the levels reached in November–December 1950, but well below the all-time heights reported in February 1911. In addition to the Sacramento system, the Truckee, Klamath, Russian, and Eel rivers also went out of control, spreading disaster to a three-state area. Farther north in Washington the precipitation was mostly in the form of snow, so no immediate flooding occurred; mountain stations received substantial new accumulations.

Precipitation totals from San Francisco Bay northward to central Oregon were in many places in excess of 10 inches for the 11-day period, 16–26 December. The greatest catch, according to preliminary reports, was 30.81 inches at Blue Canyon in north-central California. Many other stations had amounts exceeding 20 inches.

The principal damage occurred when the Feather and Yuba rivers, which drain the area of maximum precipitation, went on rampages, breaking dikes and flooding populated areas. Two major levee breaks sent the Feather River into the heart of Yuba City (population 5,000) with 6 to 8 feet of water in the main streets. Yuba City was twice evacuated during the crisis. Marysville, across the river, was also a sufferer. The rich "Peach Bowl" area nearby was inundated with an estimated 30,000 acres under water.

High winds accompanied the storm along the entire coast. Gusty winds of whole gale force did considerable structural damage from San Francisco northward. In all, flood damage has been estimated in the press at $150 million and 74 persons were reported dead.

Tornadoes During 1955



ROBERT G. BEEBE, *Severe Local Storm Warning Center,*
U. S. Weather Bureau, Kansas City, Missouri

The funnel of the Scottsbluff tornado on 27 June 1955 was snapped by J. E. Jarrell of Scottsbluff, Nebraska. Camera was three miles from funnel and pointed east-southeast.

TORNADO occurrences during 1955 continued to set new records—a characteristic of climatic data on these destructive storms since the inauguration of tornado forecasts a few years ago. Around 900 individual tornadoes have been reported to the Climatological Services Division of the Weather Bureau and their locations are shown on the map. These tornadoes and associated winds, hail, and rain, resulted in the loss of about 150 lives along with property damage estimated at $50 million.

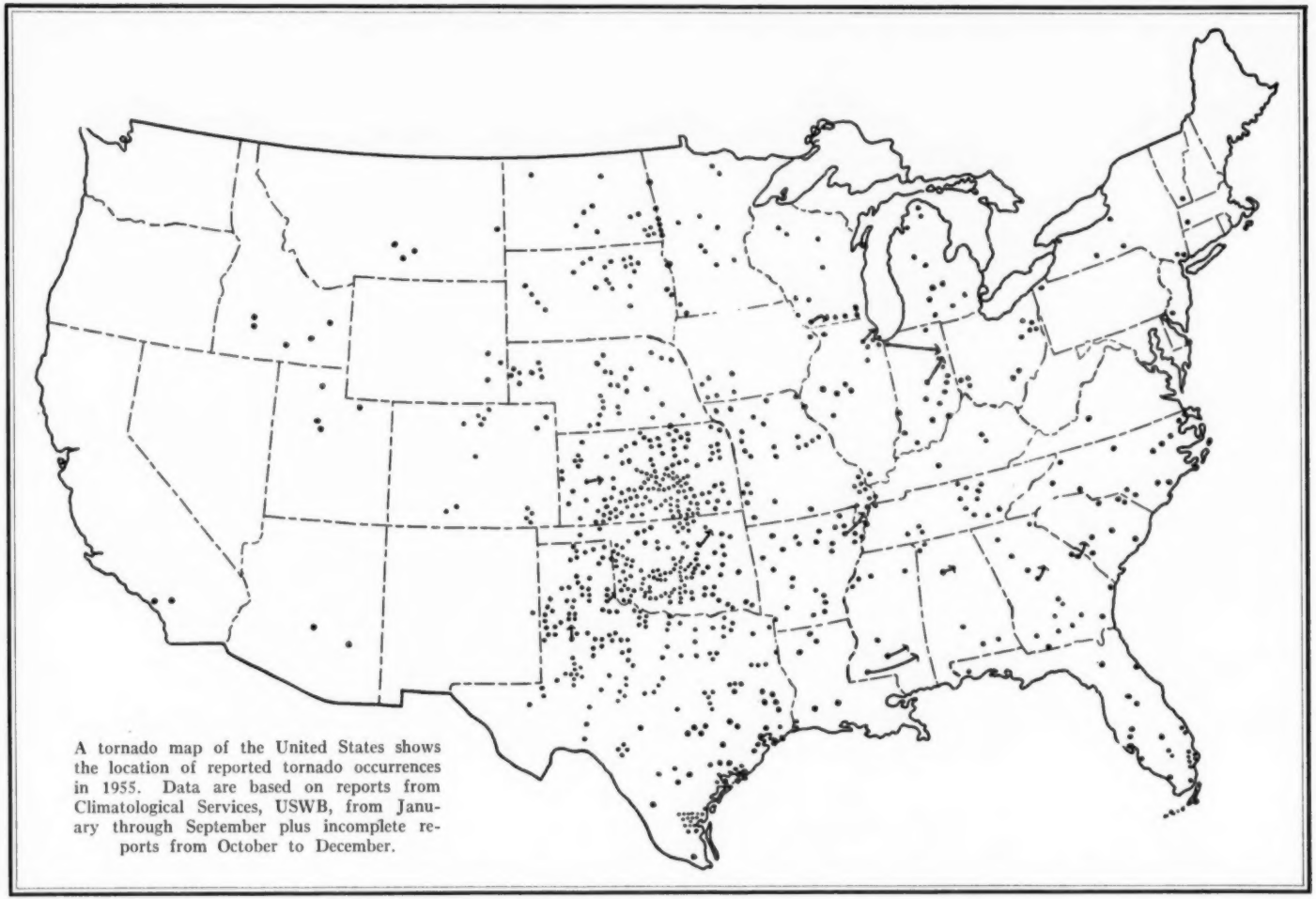
The most devastating tornado situation of the year, the Blackwell-Udall storm, began during the afternoon of 25 May. These storms snuffed out the lives of 102 persons, injured nearly 600 others, and laid waste to property estimated at nearly $12 million. The first tornadoes in this series formed over western Oklahoma and the Texas Panhandle shortly after 1500 CST. Later in the afternoon, other tornadoes developed over northern Texas, central Oklahoma and over southern Kansas and Missouri during the evening. While over 30 individual storms were reported in this situation before dissipating during the early morning hours of 26 May, two tornadoes were responsible for most of the lives lost, injuries, and property damage.

The first of these struck Blackwell, Oklahoma, at 2126 where 20 people were killed, 280 injured, and some 900 homes were either destroyed or damaged. Property damage here exceeded $8 million. While this tornado was still churning northward, a second funnel formed a few miles to the east. This storm followed a northerly course towards Udall, Kansas, where it subsequently struck with tremendous force at 2235. This tornado all but destroyed the town of Udall—not a building was left untouched. Among the 500 inhabitants of Udall, 75 were killed and around 250 injured, with property damage of was over $2 million.

The second most death-dealing tornado situation occurred on 1 February, the first day of the "tornado season," which has been arbitrarily defined as 1 February through 31 August. While these storms were originally classified as "wind storms," further study of the damage, newspaper clippings, and reports by meteorologists familiar with tornado characteristics left no doubt but that tornadoes were responsible for a major part of the destruction here. These storms formed over central Arkansas at 1345 with other storms developing over northern Mississippi a little later, and ending over northern Alabama early in the evening. Twenty-three persons were killed by this series, 189 injured, and property damage amounted to over $800,000.

Four other tornado situations were responsible for property damage of over $1 million each. The first occurred from 1515 to 2100 on 3 March in northeastern Illinois and northern Indiana. Although damage amounted to $1.3 million, there were only three injuries and no fatalities. Indiana was struck by tornadoes again during the afternoon of 11 March. Though no lives were lost, eight injuries and property damage of $1.52 million resulted. During the early morning hours at 0530 of 5 April, a series of tornadoes struck in north-central Texas. Almost every house in Stamford, Texas, suffered some damage, but fortunately there were no fatalities. Some 1150 buildings were damaged; seven persons were injured; and property damage amounted to a little over $1 million. Less than 24 hours later at 0220 on 6 April another series of tornadoes formed in about the same area. As the storm setting moved eastward, numerous tornadoes wreaked havoc along the northern Texas border, killing one person, injuring 55 others, and causing property damage of around $3 million.

One of the most interesting series of tornadoes, from the viewpoint of the researcher, occurred in Scottsbluff County, Nebraska, during the afternoon of 27 June. Two persons were killed, 20 injured, and property damage was estimated at $450,000. These tornadoes (at least 12 were confirmed) were unquestionably the most photographed in history. Pictures of the funnels include some 75 black and white photos, 35 Kodachrome slides, and 10 movies on Kodachrome film. These photos were taken at many different



A tornado map of the United States shows the location of reported tornado occurrences in 1955. Data are based on reports from Climatological Services, USWB, from January through September plus incomplete reports from October to December.

locations and times, thus providing considerable detail. In addition, several photos of the radar scope were made as one tornado moved within a mile of the radar. Several damage photographs were taken, including aerial shots of a cemetery where one funnel moved across the center. Tombstones, some weighing as much as 3,000 pounds, to the south of the path were blown over to the east, while those to the north of the path were blown over towards the west. Thus, there is no doubt that this tornado contained a cyclonic circulation. The thunderstorm cell, from which the tornadoes developed, moved down the North Platte Valley at 12 knots. Visibility was excellent around this cell and ceilings remained generally above 4,000 feet. Timely forecasts and warnings from the Weather Bureau augmented by on-the-spot descriptions by mobile units from radio stations KOLT and KNEB, along with excellent visibility conditions, permitted many very good observations of cloud conditions, funnel development and history, and manner of destruction. Also, there were several witnesses near the core of one funnel who lived to give detailed descriptions. A complete file of the photographs is now at the Weather Bureau Library in Washington and some pertinent details on this storm will be published in the November issue of the *Monthly Weather Review*. One of these interesting photographs is shown above.

Increased Congressional appropriations to the Weather Bureau research program on severe storms has resulted in accelerated progress in the study of tornadoes. Research on the tornado model, based in part on evidence found in tornado damage surveys, is being carried on at several universities in the Middle West. Other groups are taking a fresh look at synoptic associations in connection with tornado developments. The Weather Bureau sponsored a Conference on Severe Local Storms in Washington on 14–16 December. Participants in this conference, which included over 100 researchers whose interests covered many aspects of tornado research, critically reviewed the present state of knowledge of tornadoes and discussed ways and means of future research.

One of the more interesting phases of tornado research during 1956 is expected from the tornado research airplane. Present plans include an airplane probe of tornado forecast areas before, during, and after activity. The airplane is a P-51 to be flown by Jim Cook of Jacksboro, Texas. The objective is to determine gradients of temperature and humidity in both the horizontal and vertical plane, as well as to record other interesting observations.

Considerable data on tornado occurrences, fatalities, injuries, and property damage have been compiled over the years. However, the question as to whether a particular storm was a tornado or wind storm is often difficult to answer and the classification is necessarily a subjective one which could vary from one meteorologist to another. Emphasis has recently been placed upon more detailed reports regarding the tornado and the resulting damage in order to provide further data for research and to facilitate the classification of storms. Questionnaires are sent to localities where severe local storms have occurred to obtain details regarding the location, time, and movement of storms; casualties and losses; descriptions of the funnels, including direction of rotation (few authentic descriptions of direction of rotation are actually received); hail and rain pattern relative to the storm; unusual electrical discharges or noise; and pressure readings. It is hoped that data of this kind will augment our knowledge of the structure of tornadoes and the thunderstorm cell with which they are usually associated.

In addition to the data listed above, the SELS Center is very much interested in photographs of tornado funnels. Photographic records of tornado development (for example, see the *Bulletin of the AMS* for September 1955) or tornado dissipation are especially desired. Also, it would be desirable to have photographs with reference objects in the picture so that, knowing the location of the funnel and the exact place and time at which the photographs were taken, the dimensions of the funnel could be computed later. Finally, there are undoubtedly many interesting accounts that should be called to the attention of those conducting research on these problems. The Weather Bureau's SELS Center (Severe Local Storms Warning Center), 911 Walnut, Kansas City 6, Missouri, would welcome such accounts or photographs.

A street scene in Ft. Scott, Kansas, after a record snowfall of 26 inches had stalled traffic on 28 December 1954. Snow drifts covered parking meters. Wide World photo.

Snowfall Notes for Winter 1954–55

DAVID M. LUDLUM

NEW ENGLAND—The early snows of October and November were of little consequence, but December brought joy to the hearts of winter sports fans with generous snowfall in all sections except parts of Connecticut. An early December storm moving down from Hudson Bay on the 6th dropped a heavy cover on eastern Massachusetts with Cape Cod and Nantucket getting the heaviest falls of 7 to 10 inches. Very hazardous driving conditions resulted all over New England. On the 21–22nd a coastal storm spread a deep covering from Rhode Island to southern Maine. Portsmouth, New Hampshire, reported a locally very heavy fall of 22″.

The record-breaking dryness of January was the outstanding feature of the precipitation pattern of the entire winter. In southern New England snowfall was at a record all-time low for the month, the average fall being only 1.5″. It was a different story along the northern border areas which received frequent small accumulations from depressions moving up the St. Lawrence Valley. At Ft. Kent in extreme northern Maine the cover built up to a maximum of 63″ on the 20th, and the airports at Caribou and Presque Isle reported 50″ on the ground.

February continued the earlier regime and was again below normal in southern New England, but well above in Maine, New Hampshire, and Vermont. The principal storm of the month swept Maine on the 17–18th and deposited up to 25″ of new snow. The very deep cover in northern Maine was reduced somewhat by mid-month, but the storm of the 17–18th built up amounts again. At the end of

February Caribou had 29″ and Ft. Kent 49″. Cover in Pinkham's Notch at the base of New Hampshire's White Mountains was 33″, while in the lower elevation ski resorts in Vermont 12″ was on the ground. It was the best all-around skiing season since 1947–48.

Continued heavy snows in northern New England maintained the cover in March so that depths were about the same at the end of the month as at the beginning. Caribou and Presque Isle had a 36″ base on 31 March. In southern sections the early spring snowfall was below normal, and cover had disappeared after the light falls on 26–27 March.

The only April storm of consequence in the entire area was a rather localized fall that caught traffic unawares on a Sunday afternoon. Up to 25″ were reported in northwestern Connecticut, and the heavy covering spread into western Massachusetts and southern Vermont. Coastal areas had rain.

Without April additions or cold weather the deep snow cover in northern New England went off rather quickly, but without serious flooding. At Caribou, Maine, the last measurable amount was reported on 18 April; at Pinkham's Notch on the 15th; at First Connecticut Lake in extreme northern New Hampshire on the 21st; and at Newport, northern Vermont, on the 9th—a rather early ending to such a big snow season.

MIDDLE ATLANTIC STATES—The large industrial cities of the East were generally situated in a fortunate position in regard to traffic-hampering snowfalls. Most of the Middle Atlantic states were inbetween two snow belts: one in North Carolina and Virginia, and the other along the northern border. Furthermore, it was a rather dry winter season throughout the area. Snowfall at Washington totaled only 7.6″, at Philadelphia 12.1″, and at New York City 10.9″. The main storm of the season occurred on 11–12 February with amounts up to 6″ reported.

SOUTH—Areas south of the Mason-Dixon Line, as in the several past winters, had more in the way of snowfall than is usually their share. This was especially true in North Carolina and Virginia. A coastal storm started the season on 6–7 December with a blanket of white covering the Carolinas northward to Delaware. Six inches fell in southern Virginia and four inches elsewhere. There was snow again on the 13–14th in interior valleys of Virginia.

January was an unusually snowy month in the Southeast. In North Carolina only two Januaries have produced greater amounts. The principal storm commenced on the 18–19th with a fall of 9″ at Raleigh-Durham. Despite the fact that it was a rather dry month, snowfalls were frequent. Northern Georgia and South Carolina reported two occurrences: on the 18–19th and the 23–24th, with amounts from 3.7″ at Macon to 6″ in South Carolina. The storm of the 19th dropped 15″ on Abingdon in southern Virginia and 6″ plus generally throughout southern counties. Schools were closed by this storm, in some places for two days. January snowfall in Virginia averaged 7.6″ and has been exceeded only three times.

By far the most unusual snowfall of the winter visited the Mobile Bay area of Alabama on the 23rd when conditions were just right for a low moving across the Gulf to produce snow on the immediate Gulf Coast, but not inland. Both Mobile Airport and Bay Minette reported 3.5″—this was the greatest snowfall since 1900 in the area.

LOWER LAKES—The snow season in areas affected by Lake Erie and Lake Ontario commenced with a record October fall at Cleveland of 6.1″. Similar amounts fell to the east of the Lakes and continued through 4 November. Wellsboro, Pa., reported a fall of 11″ during this period. The next November snows fell across the area on the 21–22nd, and cover built up to 15″ at the end of the month at Boonville, the snow capital of western New York, directly east of Lake Ontario.

Almost daily light snows marked December, but there were no heavy falls. Only four days at Boonville were without snowfall; the major deposit there occurred on the 8–9th with 16.7″ of new snow. Cover at the month's end at New York's snowiest location was 21″. In Ohio there was much flurry activity in December, but no major storm. At Chardon in the hills back from Lake Erie a cover was maintained until Christmas Day, but at the end of the month the ground was bare along the south shore of the Lake and elsewhere in Ohio. In the Pennsylvania mountains it was the same story.

January was a generally dry month in New York State—very dry in the east and less so in the west. Snowfall was below normal for the mid-winter month. Boonville had a fall of 16″ on the 16–17th, the only unusual storm period. In Pennsylvania the falls were about average for the month. In most areas February snowfall was confined to the first half of the month; amounts were light; and the cover had practically disappeared by the 20th. In northern New York snowfall was about normal; the principal falls came on the 11–12th, 14–17th, 22–23rd, 26–28th. Cover built up to 47″ at Boonville during the month.

Two major storms of blizzard proportions featured a very stormy March period. On 7 March central New York counties were swept by gale winds and up to 20″ of snow fell. Again on the 26–28th gale winds piled up mountainous drifts and marooned many motorists especially along the new Thruway. In the Syracuse area 23″ of new snow was reported. For the entire month Old Forge recorded 90″ and Boonville 80″; snow cover reached 56″ and 50″ on the 8th at these places, and as late as 27 March measured 56″ and 58″ deep! The very heavy falls in New York did not extend southwestward into Pennsylvania and Ohio. There was an 11″ fall at Oberlin, Ohio, on the 27th and similar amounts in the mountains of Pennsylvania, but at the end of the month cover had disappeared.

There were no appreciable storms in April aside from some moderate falls at higher elevations on the

3–4th. Snow cover was reduced from 48″ at Boonville on 1 April to a trace on the 17th.

UPPER LAKES—Winter made a late start in the Lake Michigan-Lake Superior drainage area. November and December were open months with some light snows but no severe storms. Snow cover in Minnesota was less than an inch generally as the year ended.

January brought moderate to heavy snows along the lee shores of the Lakes. Houghton in Upper Michigan had its usual heavy falls with 48″, while Munising, also in the lee of Lake Superior, had 46″. Muskegon in lower Michigan to the lee of Lake Michigan reported 30″, most of it during the last ten days. Cover increased in Minnesota and Wisconsin during the month to about a maximum of 15″ near Duluth at the month's end.

February was a very snowy month in Minnesota, being exceeded only four times since records started. The storm of the 17–20th was general; the heaviest fall occurred at Itasca State Park with 17″. The ground was covered during the month throughout the state and winter feeding of cattle was necessary. In the immediate lake areas February falls were normal, and no severe storms occurred.

March proved to be the stormiest month of the winter season. Blizzard conditions prevailed on the 21–22nd with gale-driven snows impeding all types of outdoor activity. Marquette's 17.3″ was the greatest storm total in the last eight years. Sault. Ste. Marie had a new March record total of 32.2″. Houghton again reported the greatest March totals —59.2″ new snow. Northern Minnesota and Wisconsin shared the deep falls, but amounts tapered off away from the Lakes. Snow cover was deep—Duluth 13″ and International Falls 15″ on 31 March, but this had all gone off by 8 April in the face of a warm early spring.

Cover in Upper Michigan was last reported on 10 April, a rather early date. Ice disappeared entirely from Lake Superior on 17 April.

NORTHERN PLAINS—The fall and early winter in this area were very favorable for farm work with neither cold nor snow impeding the late gathering of crops. Snowfall was very light during both November and December with the exception of a small belt across South Dakota and Nebraska which received substantial falls on 30 November. The end of the year found practically all of the Plains snowless.

In January two storms occurred across Nebraska on the 5–6th and 16–18th. Snow cover from the latter remained until the end of the month. No blizzard conditions developed during the period. Precipitation was below normal everywhere except along the immediate Canadian border.

February was featured by a severe blizzard over the Dakotas and Nebraska on the 18–20th. In South Dakota it was considered the worst winter storm since 1949. Snowfall ranged up to 14″ in central South Dakota, very near the record for a February storm. Winds of 40 to 70 mph., combined with temperature between 5° and 10°, caused great hardship. Roads were blocked, schools closed, and all outdoor activity ceased. Two lives were lost. Snow cover at the end of the month reached into central Nebraska.

March was another dry month in the area. There were no blizzard or severe storm developments. The only appreciable fall occurred in eastern Nebraska in the storm development that brought such severe conditions further east. At the end of March the western portion of the northern Plains was bare; and the east had a moderate covering increasing to the northeastward; in eastern North Dakota 6″ and Minnesota 12″ remained on the ground, and this all went off by 7 April.

PACIFIC STATES—Snowfall in the far West in November was unusually light—the average in Washington was near the lowest on record. It was not until the second week of December that considerable falls covered the mountains, increasing the cover to 54″ at Mt. Baker Lodge, Washington, to 27″ at Crater Lake, Oregon, and to 48″ at Soda Springs, California, the three main snow measuring spots in the Pacific States. In December a snowfall reached all the way to the extreme northwestern coast when Tatoosh Island reported a fall of 2.3″.

The southern Sierras had substantial falls in January as did the mountains of northern California. In Oregon and Washington, however, it was a very dry month, and mountain snow depths were generally around 50″, a rather small figure for mid-winter. These mountain areas received only light falls again in February and fear was expressed for the future water supply, but a rather intense storm in northern California on 26–27 February helped that area. The cover reached all the way to the coast at Eureka on the 27th where 1″ fell. The storm of the 26–27th brought the heaviest snowfall from a single storm on record to many localities at medium altitudes in northern California. Sierra City had 32″ and Strawberry Canyon 30″. Ground water and storage water in Oregon remained below normal, but in Washington it was about average.

California's receipt of new snow was far below normal in March with very few stations reporting accumulations. At the end of the month cover had retreated beyond the 5,000 ft. level. In Oregon March snowfall was about 150% of normal, but the snow pack did not increase substantially; in Washington the situation was somewhat better and many stations reported well over 100″ on the ground on 31 March.

In April the combination of below normal temperatures and adequate moisture along the Pacific Coast increased the mountain snow pack. As much as 81″ of new snow were reported at two California stations. In the Mt. Shasta area the April falls were the greatest ever recorded for so late in the season. The maximum depth in the Sierras on 30 April was 80″ at Soda Springs at an elevation of 6750 feet.

April snowfall in Oregon was the greatest since state-wide records were started in 1921. The plateau

of eastern Oregon had very unusual late season amounts. Crater Lake (6,475 feet) had a pack of 140″ at the end of April. In Washington the month's total falls averaged the greatest on record. Paradise Ranger Station received 116″ new snow in April to increase the cover to 232″ at the 5550 foot level.

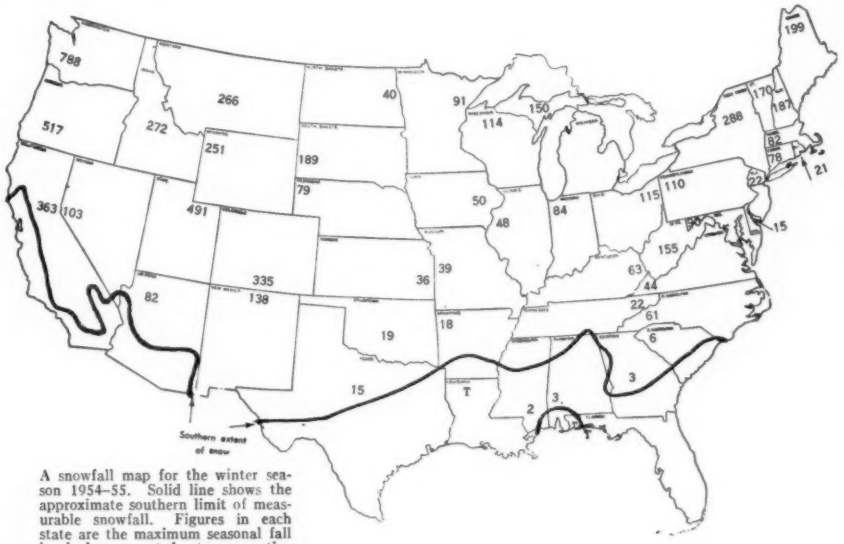
Snow cover disappeared at a normal rate in early summer. Soda Springs was bare on 18 May; Crater Lake on 13 June; Stampede Pass in Washington on 23 June.

ROCKY MOUNTAINS—It was a mild early winter in the mountains with no severe weather and little snow. Montana and Idaho had less than 50% of normal in November, and amounts in the south were negligible. There were areas in Montana, Wyoming, and Colorado that received no measurable snow in the entire month of December.

January continued the light precipitation pattern of the preceding months. In Montana and on the eastern slopes of the Rockies very little snow fell and ranges were mostly bare at the end of the month. To the west on the Plateau, however, cover ran as much as 200% of normal. Again there were areas in central Montana that received no snow at all.

The late winter and early spring reversed completely the snowfall picture and put at rest fears for the summer's water supply. All areas in the northern Rockies had generous falls. In the Lander, Wyoming, area amounts were 500% of normal. During the first week of February 20″ new snow fell there. Most of the central and northern Rockies had 200% or more of normal, and the month's end snow cover extended well into south-central New Mexico. March was a dry month in the Southwest and southern Rockies. In the north snowfall was above normal, and it was a very windy month with two near-blizzards and a great deal of blowing snow and drifting. The snow pack was about average in Montana at the end of the month.

April produced the main weather news of the winter. As reported in *Climatological Data* for April, "One of the most severe spring snowstorms of record blocked main highways and disrupted communications in north-central Wyoming and south-central Montana on the 2d, 3d, and 4th. At Sheridan, Wyoming, near-blizzard conditions continued for 43 hours on the 3d and 4th, and the 1-day snowfall on the 3d of 22.7 inches was well above the previous 24-hour record of 15.3 inches set in March 1933. The storm's total fall of 42.3 inches of snow at Billings, Mont., was a new record for all months, and the 1-day fall of 23.7 inches on the 4th was greater than any monthly total except March 1935, and the depth of 35 inches at midnight on the 4th was the greatest depth ever recorded. Salt Lake City, Utah, on the edge of the storm, reported 12.8 inches of snow which alone was a record fall for April, and 5 inches more fell on the 26th. . . . Near blizzard conditions occurred in southeastern Wyoming and the Nebraska Panhandle on the 11th and 12th, and snow was reported as far south as the Texas Panhandle on the 13th. This storm set a new record at Cheyenne, Wyo., for a 24-hour amount when 16.6 inches fell on the 11th and 12th."



A snowfall map for the winter season 1954–55. Solid line shows the approximate southern limit of measurable snowfall. Figures in each state are the maximum seasonal fall in inches reported at cooperative stations of the Weather Bureau.

Report of the Executive Secretary 1955

IN the brochures of the Society an attempt has been made to illustrate concisely the publications, services, and activities of the Society as they relate to membership. Perhaps you, as members who receive the literature, have already noted the revisions and additions to publications and activities. It is through your support as members that such healthy growth has been possible. As a middle-sized society now, more and more demands are being made upon the AMS, and it is practically impossible to keep up with all the inquiries and challenges presented, integrate the work involved in each new project into the regular operations, and still have no blacklog. It is significant that other organizations like ours express similar concern. The work of the National Register of Scientific and Technical Personnel, carried on under grant with the National Science Foundation, has afforded valuable opportunities to exchange ideas with other societies who have had longer experience in conducting their affairs. Within the ten years during which it has maintained an executive headquarters, the AMS has encountered most of the peaks and depressions known to societies operating 25–50 years. The American Psychological Society was interested enough to have a complete survey of its operations completed by a professional management service in July 1955, and a copy of this study was made available to the AMS. This report is a fascinating reflection of what similar societies attempt to do, and the repeated phrase "quality of service" is a cogent one for discussion. It is hoped that a review of the APS study can be prepared for the officers and councilors of the Society, describing comparative procedures followed by the AMS.

During 1955 an attempt was made to log the schedule of operations, priorities, and alterations within the Executive Office. This "events of the day" conveys the need for as much flexibility as possible in completion of work. The headquarters is now open nine hours a day during the week, and frequently a skeleton crew is present on Saturdays and holidays.

In reviewing the past year it appears that among the many services of the Society, guidance to education, with no limitations, and the employment service, which is exclusively for members, paid outstanding rewards. An average of 60 requests a month for guidance literature is received from counseling services. These usually receive a form response, while those from students are answered individually. The roster of members seeking new positions through the Employment Service rose from 225 in January to 360 by the end of the year.

Guidance literature was furnished in quantity for some very specialized activities during the year. The materials used and selected in accordance with the nature of these inquiries are: *Weatherwise,* October 1953 "Career and Education Issue," October 1954 "Schools Issue," August 1954 "Instruments Issue," April 1953 "Industrial Meteorology," reprints from the "Schools Issue," and a mimeographed listing of "Workshop" articles particularly suitable for high-school science classes; AMS brochures; special U. S. Weather Bureau Daily Weather Maps. Such materials in quantity were furnished for the following: Adelphi College Vocational Exhibition for College Students, held in March; Annual Engineering Demonstration Day for high-school juniors, New York University, April 16; Science Fair Project of the AMS D. C. Branch, exhibits at 70 schools in the D. C. area in April; Hondo Boys' School, Hondo, California, for a state college science class in May; Conference for Mathematics Teachers, University of Wisconsin, 27 June–22 July; Pennsylvania State University's Conference for High School Teachers of Science; Oak Ridge Institute of Nuclear Studies, summer program for high school teachers; State Employment Service for distribution to counselors in Florida; Bucknell University, Lewisburg, Pennsylvania, for the Guidance Workshop Summer Program; Tama Indian Program of the Department of Anthropology, The University of Chicago, held at Tama, Iowa; The Children's Museum, Durham, North Carolina.

The guidance service serves to publicize the AMS. More definitely on the publicity side, however, the AMS entered the Combined Periodical Exhibit, 74th Annual Con-

ference of the American Library Association in Philadelphia, Pennsylvania, 3–9 July. A poster was furnished along with 1000 publications brochures and 300 sample copies of *Meteorological Abstracts and Bibliography.* Five hundred brochures, applications for membership, 100 reprints from the "Schools Issue," *Weatherwise,* and 80 sample copies of other issues were shipped to Mt. Washington Observatory, Gorham, New Hampshire, for summer visitors. Materials were furnished to the Meteorology Department, University of Utah, for its booth at the Utah State Fair 16–25 September. Also in September sample copies of the *Abstracts* and AMS brochures were mailed to Bad Homburg, Germany, for the 1955 Conference of the German Society for Documentation. Thirty sample copies of *Weatherwise* and AMS brochures were used by Mr. E. A. Murphy of M.I.T. for his class in the Popular Lecture Series of the Museum of Science, Boston. AMS brochures were furnished to Science Associates for inclusion with the mailing of their new instrument catalog. An article on employment outlook for meteorologists was furnished to Prof. Hans Neuberger, Head, Department of Meteorology, Pennsylvania State University for the placement issue of *Mineral Industries,* December 1955. Now being worked out with the U. S. Weather Bureau is an article on the Society's activities for the back of the U. S. Daily Weather Map.

Employers who have contacted the Society for weather personnel in 1955 are listed below; in this list are included opportunities for fellowships, assistantships, and study abroad. (Write Executive Society for copy of list.)

* * * * * *

The following examples of cooperation with groups of members and external agencies may be mentioned as additional services of the Society. Thirty applications and copies of the revised "You and the Weather" were sent to each local branch in July. Members undoubtedly enjoy reading the new section in the *Bulletin* started in the September issue, "News From Our Local Branches," the material for which is collected, written, and sent to press along with other notes, news, and announcements from the headquarters office. A directory of local branches is sent to each new member of the Society as part of acknowledgment materials. Local branches receive cooperation from the Executive Office in furnishing lists of members within the areas of branch activities. As much assistance as is required is extended at times when local branches sponsor national meetings of the AMS. This is accomplished through announcements in the *Bulletin,* printing and reprinting of the program, distribution of the program to authors and chairmen (with a request for copies of papers or information on where they are to be published), to the publicity release list of one thousand organizations and individuals, advertising, and sponsors for cocktail parties. Unfortunately, only two prominent speakers were obtained for a local branch during the year, and it would be helpful if more members would alert the Executive Office about their travels, in case they might be interested in speaking at local branch meetings. The Society has been able to assist the Air Force Cambridge Research Center, however, by suggesting guest speakers for its seminars.

Prior to publication in the *Bulletin,* the Report of the Committee on Radar was mimeographed and mailed to a list of 112 persons selected by the Committee Chairman. Reports of technical committees, if published in the *Bulletin,* are always available in the Executive Office. These reprints are also distributed to the publicity-release list and used in answering individual inquiries. Two hundred copies of the program of the AMS meeting in Atlanta (held along with the Program for the International Geophysical Year in conjunction with the American Association for the Advancement of Science) were furnished to the U. S. National Committee of the IGY for distribution to technical panels. The mailing of the Atlanta Program as a publicity release provided an opportunity to include a listing of local branches, calendar of AMS national meetings, and a list of technical reports on Air Pollution of the Air Pollution Foundation, Los Angeles, California. The latter listing was limited to officers, councilors, universities, corporation members, the AMS Air Pollution Abatement Committee, and private weather services. Information on proposed legislation was requested from Senator Case of South Dakota in September for

mailing to the AMS Committee on Agricultural Meteorology. In this connection, an attempt is made to keep abreast of all legislation pertinent to weather so that it can be passed along to committees.

Inquiries needing personally composed letters from the Executive Office are now averaging 500 a month. This does not include the form letters, reprint order forms, invoices (1321 for 1955), and mimeographed materials necessary for daily operations. In September, 536 letters to "unpaid" members were sent as the third reminder for the year; this number was reduced to 313 at the end of the year. A serious problem, too, is the large number of changes of addresses of members, now averaging 3000 a year.

With the mailing of the Oklahoma Meeting Program on 24 September, a mimeographed preliminary program for the Honolulu Meeting was included. Employment notices were mailed in February, March, May, June (plus a special notice to universities for posting), July (plus a special notice to those members in the New England area), September, October, November and December. These notices reflect the various employment opportunities available for professional meteorological personnel and the need for research workers. Other requests from employers who prefer a listing of personnel for specialized positions are not included in the employment notices, but the employment roster of members is used in preparing such lists. Business and industrial organizations request information on private weather services and meteorological consultants; for these a reprint of the Professional Directory Page, *Bulletin,* is provided. For other specialized weather needs, lists of professional members in certain geographical areas may be furnished as possible consultants.

Between 19 July and 19 August, 1450 AMS brochures and applications were mailed to nonmembers who had returned the first questionnaire for the National Register of Scientific and Technical Personnel. The nonmember file is extensive and has grown approximately five-fold during the five-year period since it was established. Any individual who contacts the Society for any reason whatsoever, whether he requests a reprint order, a single issue of a publication, or is a guest at a national meeting, is acquainted with AMS activities through the mailing of brochures. Regularly lists are processed from the universities, military services who are willing to cooperate, the U. S. Weather Bureau, business and industrial organizations who employ meteorologists. Still there remains the fact that many more individuals could support the Society through membership. Since the July and August mailings, an additional 2200 brochures and applications have been mailed through use of the nonmember file, and this supplementary canvass has so far reached only the letter *C* in the alphabet.

Among forthcoming publications, members can expect the appearance of *A Glossary of Meteorology, Dynamic Meteorology and Weather Forecasting,* and *Meteorological Research Reviews* in 1956. *The Journal of Meteorology* has increased 10 per cent in number of pages over 1954. No *Monographs* have been published, but the Editor has four interesting manuscripts at hand for review, however, and the tables of contents of *Monographs* numbers 7 and 8 in mimeographed form are being distributed. Special AMS publications listed in the brochures, such as the *Compendium of Meteorology* and *Proceedings of the Toronto Meteorological Conference 1953,* continue to be ordered along with issues in the *Monographs* series. Further contractual support has been received for the *Meteorological Abstracts and Bibliography* from the Quartermaster Research and Development Center and the U. S. Weather Bureau.

Not all of the Society's business can be done by correspondence and printed publications. Telephone calls are numerous to the headquarters. Editor Rigby's services on the *Meteorological Abstracts and Bibliography,* with offices in Washington, D. C., are repeatedly sought by organizations and individuals because of his invaluable and unique knowledge of meteorological literature. In March, a celebration for Mr. Rigby given by the staff on *Abstracts* brought messages of congratulations from all parts of the world. The Supervisor of the AMS Translation Project, David Kraus, has been asked by universities in the Boston area to give seminars on scientific translation problems. The very good location of Editor Huschke's office, in preparing *A Glossary of Meteorology,*

(Continued on page 34)

Greetings (*Continued from page 4*)

special projects, one to investigate tornadoes, the other hurricanes, both on a far larger scale than anything ever attempted before, are now getting under way. At long last a real attack is to be made on these two most threatening types of severe storms.

Total Weather Bureau appropriations finally voted by Congress for the fiscal year 1955–56 amounted to $39.5 million, or about $14.5 million more than for the previous year. Some of this increase will go to take over stations previously operated by the Military. Nevertheless, the Congressional Record's report of the hearings on this year's appropriation bill makes it abundantly clear that, for the first time since we can remember, the Weather Bureau has *all* the funds it can use, and in fact is encouraged to go back to Congress for a supplemental appropriation in the event the above funds later prove to be insufficient. This is a significant and healthy change in the attitude of Congress toward the Weather Bureau. At long last the Weather Bureau has the money to do the job it has long failed to do through lack of funds.

To look ahead instead of back for a moment, exciting events loom on the horizon. In the field of aviation, with which meteorology has been so inextricably interwoven, this year will see the use of airborne radar on commercial airliners on a large scale, providing smoother, more comfortable trips and more dependable service. In a couple of years commercial jet transports operating at 30 to 40,000 feet at speeds of 500 to 600 miles per hour will make new demands for meteorological information, while at the same time providing new weather data. The application of atomic energy to aviation has all sorts of meteorological implications. Reaching to the very outer limits of our atmosphere, we may expect to see man-made satellites coursing through the skies before the end of this decade. Then, too, the International Geophysical Year in 1957 will make great contributions to our fund of knowledge of the atmosphere over the far corners of the globe. Yes, interesting days lie ahead for all of us in this fascinating, if at times exasperating, field of weather.

Hurricanes (*Continued from page 13*)

winds reported by aerial reconnaissance crews were about 90 mph on the 28th and 29th. The lowest pressure in the center was 29.26 inches.

Flora

An easterly wave, which passed the Cape Verde Islands on 31 August, is probably the one that developed into Hurricane Flora which was first reported 3 September. As shown in figure 1, Flora followed a parabolic path and recurved to the north-northeast well to the east of Bermuda. At no time did it threaten any land area.

Gladys

Tropical storm Gladys developed in the Gulf of Campeche and moved north-northwestward on 4 September. On the 5th the storm recurved and moved south-southwestward and crossed the Mexican coast near Tampico. Highest winds at Tampico were 48 mph. Rains were about five inches near Brownville and 25 inches in three days in the Tampico area.

An area of heavy squalls began on the Texas coast on 5 September and moved inland on the 6th. Highest winds in squalls in Corpus Christi-Port O'Connor area were about 45 mph, but an oil rig 15 miles east of Port Aransas, Texas, reported winds 55 to 65 mph.

Damage in the Corpus Christi area from these squalls was estimated at $500,000 and occurred principally to streets, beach installations, piers, and small craft. The Naval Air Station at Corpus Christi reported 24-hour rainfall of 12.23 inches.

Hilda

A strong easterly wave appeared in the Leeward Islands on 11 September and developed into a hurricane north of the Mona Passage the next day. This storm followed an undulating track toward the west throughout its history. Hilda passed north of Dominica, across extreme southeastern Cuba, the Yucatan Peninsula, the Gulf of Campeche, and entered Mexico near Tampico. Hilda killed four people and caused $50,000 damage in eastern Cuba. Hilda lost intensity while crossing the mountains of eastern Cuba

but regained violence over the Caribbean and pounded the sparsely populated coast of the Yucatan Peninsula between Chetumal and Cozumel with winds estimated at over 100 mph.

Although Hilda weakened somewhat passing over the Peninsula, it regained fury crossing the Bay of Campeche and entered the coast of Mexico near Tampico on the 19th. Highest winds measured there were 105 mph when the anemometer blew away. Afterwards the winds were estimated up to 150 mph.

Floods in the Tampico area were responsible for most of the casualties. Newspaper reports indicated there were 300 deaths and $120 million damage.

Ione

While Hilda was passing south of Cuba, Ione developed in an easterly wave and reached hurricane intensity the night of the 14th. In general, the storm followed a northwesterly course until it approached the North Carolina coast which she crossed near Morehead City early on 19 September. Ione moved very slowly and erratically through eastern North Carolina the remainder of that morning and then started accelerating slowly and recurving towards the northeast.

Ione reached its greatest intensity on the 17th when the central pressure was 27.70 inches and the maximum winds were estimated at 125 mph. After this date the central pressure was estimated to be about 28.00 inches and the strongest winds slightly above 100 mph.

Ione was the third hurricane to pass through eastern North Carolina within five weeks and the fourth in about eleven months. This is the first time of record that so many hurricanes have affected the area within such a short time.

Mr. C. M. Palmer, Meteorologist at Wilmington, in describing the damage, wrote, "Most of the damage to crops by Hurricane Ione was by water. Thousands of acres of crops in the area, especially corn, potatoes, and soya were completely ruined. Farmers are buying food from town vegetable markets. Water is reported standing 3 and 4 feet in fields. Highways in parts of the area are now, five days later, still under water in places and impassable. . . . New Bern, N. C., reported 40 blocks under water at one time. . . . Because of its slowed movement, the hurricane caused more rain to occur in the area than any other hurricane passing through the area." The greatest amount reported was 16.63 inches at Maysville, and storm totals were in excess of five inches for a distance of 60 to 100 miles on either side of the path.

Mr. C. B. Carney, Meteorologist at Raleigh, N. C., wrote "The principal damage occurring in Ione was due to water. Since the approach of Hurricane Connie on 10 August, eastern North Carolina has been repeatedly drenched with heavy rains. More than 30 inches fell on the wettest portions of the State between that time and the approach of Ione; the 16 inches that dropped on those same areas in connection with Ione brought 42-day precipitation totals up to figures without precedent in North Carolina weather history. In the 42-day period, 11 August through 20 September, the cooperative situation at Maysville reported a total of 48.90 inches of rain. This unprecedented rainfall, approximately one-third of it falling in about 30 hours with Hurricane Ione, produced the heaviest runoff of record on downstream tributaries and coastal creeks in North Carolina. . . . The combination of tide waters from the east, and flood water from the west inundated the greatest area of eastern North Carolina ever known to have been flooded. In at least one city, New Bern, the depth of water was the greatest of record.

"In all, five deaths from drowning in North Carolina were attributed to Ione, and two deaths from automobile accidents were brought on by the flood waters. In addition, one or two heart attacks are believed to have been induced or aggravated by the storm. . . . The estimated property damage due to the storm and resultant flood conditions is $88 million."

Janet

This was the most severe hurricane of the season and caused more deaths than any other hurricane of 1955. Although it did not at any time approach continental United States, it did take the lives of U. S. citizens. A Navy reconnaissance plane with a crew of

nine plus two Canadian newspapermen was lost in the hurricane south of Cuba on 26 September. No trace of the plane or of its crew has been found.

Janet developed east of Barbados 21 September, and passed a short distance south of that island on the 22nd, then passed through the Grenadines in the Windward Islands. In Barbados 38 were killed and in the Grenadines 122 were lost. Highest winds reported at Barbados were slightly over 100 mph. Property damage at Barbados and in the Grenadines was in excess of $2.8 million.

Janet continued to increase in intensity as it furiously spun across the Caribbean. By the 27th the central pressure was 27.55 inches and maximum winds greatly in excess of 100 mph. The center passed very near the Weather Bureau's station at Swan Island. The winds there were measured at 135 mph before the instruments blew away and were later estimated as high as 200 mph.

The hurricane passed inland over the Yucatan Peninsula near Chetumal. The death toll and property loss in northern British Honduras and southern portion of Quintana Roo Province of Mexico will probably never be known, but it is estimated that more than 500 were killed, 100,000 left homeless, and property damaged in excess of $40 million. The lowest pressure was 27.10 at Corozal, British Honduras, and 27.00 inches at Chetumal, Mexico. The winds were measured at 175 mph at Chetumal before the anemometer collapsed. The town of Corozal and surrounding villages within a radius of 20 miles were completely demolished.

Janet lost force crossing the Yucatan Peninsula, but its highest winds were over 100 mph when it reached the Mexico coast in the Vera Cruz-Nautla area. It went inland in a sparsely settled mountainous section and little information is available as to damage caused there by the winds. The flood resulting from the rains associated with Gladys, Hilda, and Janet, however, is probably one of the greatest disasters ever to occur in the Tampico area.

Katie

This hurricane formed 16 October in the central Caribbean from a wave on the intertropical convergence zone. It moved north-northeastward and struck the coast of Hispaniola near the Haiti-Dominican Republic border about midnight 16–17 October. Hurricane winds were estimated at 115 mph. Four deaths due to drowning have been reported.

Katie lost intensity while crossing the mountains of Hispaniola, but almost regained hurricane force after passing into the Atlantic. It soon reached an area of cold air, however, and again weakened. A small vortex continued moving northeastward and passed about 100 miles east of Bermuda.

With the death of Katie, on 19 October, the 1955 hurricane season became history. It had started early—1 January—and had been an extremely active one. It will long be remembered for its floods by people from Pennsylvania to New England and for its compressed fury by the people who looked Janet in the eye and lived to tell the story.

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Weatherwatch

Winter Strikes Early in 1955-56

DAVID M. LUDLUM, *Editor*

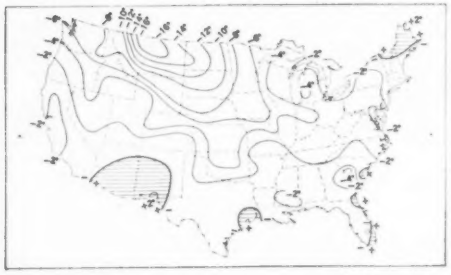
The early winter of 1955–56 will live long in the memory of those who felt the contrasting effects of its extreme cold and later warmth, of its devastating floods and threatening droughts. As may be expected when westerly control of the circulation is at a low ebb, the 3,000-mile breadth of the continent was treated to a grand variety of weather fare. With the westerlies far south of their normal track, the way was open for an outflow of cold, dry air from the interior to reach almost all the United States except the Mexican border regions. And when the monsoonal outflow slackened, the maritime air masses rushed inland; as if to make up for lost time, they created vast floods on the Pacific Coast and record mildness in much of the interior. Early in January the maritime forces of the Atlantic rallied, too, and gave the Northeast a period of unequaled duration of mild, rainy weather in a dramatic reversal of the weather circulation.

Although there were gradual changes in the mean pressure distribution from November to December, the chief features of a low index of westerly circulation were readily apparent on each month's map. At the start of November the index of westerly flow reached the second lowest figure ever observed in either October or November. Furthermore, the index remained low throughout November and until the last week of December, the longest such consecutive period since the index has been compiled.

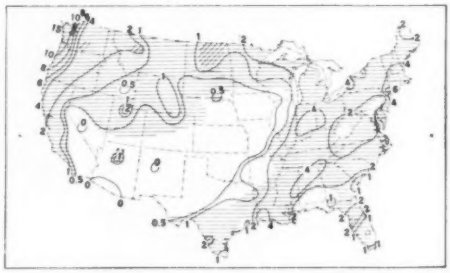
The outstanding objects on the mean circulation maps of November and December were two areas of much above normal pressure: one in the Gulf of Alaska area in the Northwest and the other in the Davis Strait area between Greenland and Canada in the Northeast. Thus, high pressure was found in the nearby haunts of the Aleutian and Icelandic lows. These two great blocking anticyclones persisted throughout the 60-day period to distort the usual west-to-east flow of the atmosphere across our nation. Pressure was generally below normal over northern and central sections, and slightly above normal over southern United States. This made for a tight gradient and stimulated an active parade of weather events. The only continental trough of note trailed southward from a minor low center over central Quebec, across Lake Michigan, and southward to Texas. Since little moisture was fed into this trough, there was little storm activity in the central interior.

The large ridge over the Gulf of Alaska extended eastward over the mainland and prepared the stage for processing great masses of intensely cold air over the Alaskan interior and northwestern Canada. These swept southward in great surges during a seven-week period over the mountains and plains into the trough over the Mississippi Valley. The coldness of these air masses was remarkable. Only

MONTH OF NOVEMBER 1955



Departure of Average Temperature from Normal in degrees Fahrenheit. USWB chart.



Total Precipitation in Inches. USWB chart.

once before, in 1896, has November been colder in the Northwest and northern Plains, and never before in November has such an absolute degree of coldness been reached! The period 11–17 November 1955 was the coldest mid-November period on record there. At Helena, Montana, the temperature was continuously below zero for 138 consecutive hours, a stretch never before equaled in any month. New all-time November minima were set by wide margins in many locations. For example, Salt Lake City, Utah, registered $-14°$ F. on the 16th—a mark 14 degrees lower than any previous November reading. The cold penetrated to the Pacific Coast in the Northwest where Tatoosh Island registered a new November record of 19° and Seattle set new daily minima records from the 11th to the 17th. Crop losses in the Northwest from cold and snow were heavy, and this followed a very cold spring season when crop damage was also severe.

The month of December produced three main meterorological features: a continuance of the early-season cold spell until the 20th over all regions except the Southwest and the immediate central Pacific Coast, an extreme winter dryness from the Rocky Mountains to the East Coast, and during the latter half a series of violent cyclonic storms and rains in the Pacific States which resulted in disastrous floods.

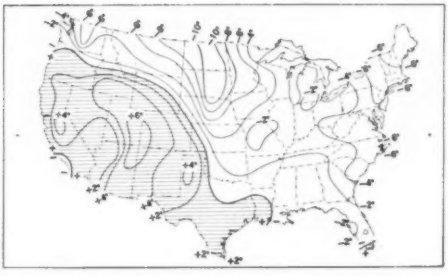
The main blocking features of the November weather maps carried over into December, but as the month progressed the two anticyclones shifted positions and were less intense in their abnormality. The mid-continent was covered by ridge conditions, while off each coast important troughs were in the stage of development. A marked low pressure trough developed off the Pacific Coast as the chief pressure feature change from November. This, in conjunction with a strong ridge in the Aleutian Islands area, generated a period of very stormy conditions in the North Pacific Ocean. Deep depressions moved out of the trough after the 15th to lash the entire Pacific Coast. Since the trough extended southward into tropical regions, sources of warm, moist air were tapped and drawn northward. With very cold air still overlying the interior, a great energy contrast was set up, accelerating a swift southwesterly flow, sometimes reaching 100 mph in gusts, from the warm ocean inland across the coastal mountain barriers. Rainfall in excess of 30 inches fell in an 11-day period, creating tragic flood conditions in northern California at Christmas time.

East of the Rockies the only significant rainfall of the month fell in a localized area along the central Gulf Coast. Elsewhere it was a droughty month as the outflow of dry air from the interior of Canada prevented any maritime air masses penetrating the interior until after the 20th. It was the driest December on record at such diverse places as west Texas and New Jersey. A band of less than 0.50 of an inch monthly precipitation extended from San Diego to New York City!

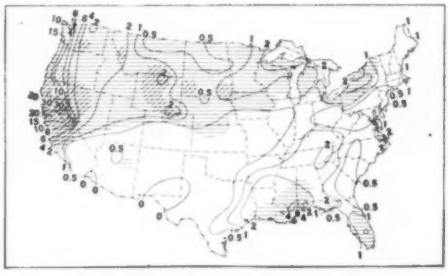
The cold regime continued in the Northwest and the northern Plains for the first ten days, but the main axis of flow of the extremely cold Arctic air tended to move eastward during the month—at the same time the Pacific States warmed up as maritime air was able to reassert itself after its long exclusion. The climax came on 18–20 December when the last great outbreak of Arctic air flowed southeastward. This time Minnesota was at the core of the cold air and the mercury in the Big Falls area plunged to $-46°$. But Pacific air was borne eastward by the great cyclonic storm which entered the Pacific Coast on the 20th, and soon penetrated into the Plains and the middle Mississippi Valley to bring a very moderate pre-Christmas period with 70° reported as far north as St. Louis, Missouri, on 24 December.

The Northeast, however, remained under the influence of the offshore trough extending from Nova Scotia southward. Northwest flow out of Canada kept temperatures below normal in the middle Atlantic States and New England to the month's end, making it generally the coldest December in that area since 1926. In New York State the temperature dipped as low as $-40°$ at Stillwater Reservoir. The continued continental flow prevented any maritime air from crossing the coastline, so precipitation was at an all-time low in much of the region along the Atlantic Coast. In the New York City area the persistence of low temperatures and the absence of snow permitted ice boating for the first considerable period since 1940.

MONTH OF DECEMBER 1955



Departure of Average Temperature from Normal in degrees Fahrenheit. USWB chart.



Total Precipitation in Inches. USWB chart.

Report of Executive Secretary

(*Continued from page 28*)

adjacent to the Translation Project Office has provided the opportunity for an unusual exchange of ideas and information between the two areas of activity. Further evidence of interest in the field is found in the number of local branches of the AMS, now 34 with one additional petition for organization pending Council action at the end of the year; the eight national meetings of the Society in 1955, the 47 corporation members with two additional applications being processed for payment, and the 22 private weather services in the Professional Directory Page. The membership should be proud of the hard working committees whose important results have been so very much needed in coordinating the affairs of the AMS.

Members and guests during the past year who visited the headquarters office to become acquainted first-hand with the activities were: (This list may be obtained by writing the Executive Secretary).

* * * * * * *

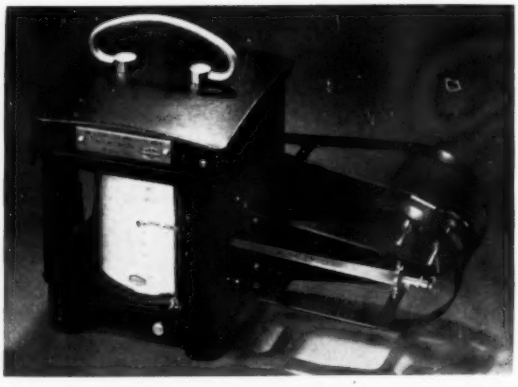
Appreciation is due the officers and councilors of the Society for being on hand so many times throughout the year, President Arthur F. Merewether, Secretary Henry G. Houghton, Honorary Secretary, and Councilor Charles F. Brooks, and Treasurer Henry DeC. Ward.

One illustration of AMS efforts to benefit the meteorological profession merits special mention. At the request of the U. S. Civil Service Commission, factual information was furnished on certain aspects of employment of meteorological personnel. In addition the IBM cards on meteorologists in the National Register of Scientific and Technical Personnel, data collected by the AMS on members and nonmembers through grant from the National Science Foundation were assembled at the Bureau of Census in Washington. The salary figures for those replying to the questionnaire may be obtained from the Executive Secretary. The Civil Service Commission has informed us that the entrance salaries at the GS-5 level have been raised from $3670 to $4345 per annum as of 4 November, and it is obvious that data supplied by the AMS were a major factor in reaching this decision.

In closing this report, it seems appropriate to point out that an interesting pattern is beginning to take shape in letters from young Associate Members. Affiliation with the AMS and reading *Weatherwise* have apparently stimulated considerable enthusiasm for entering meteorology as a career among the teen-age group and some even younger.

The AMS has opened new and diverse channels in fulfilling its purposes, but more and more areas appear as meteorologists advance and broaden the field.

Thermograph



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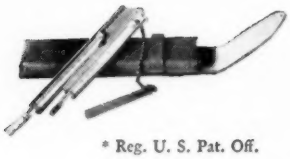

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